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EDITORIALS

THE PROBLEM OF VENTILATION.

The discussion before the American Public Health Association at its Richmond meeting on the various aspects of ventilation was a timely one. The problem of ventilation is largely an engineering problem, but, as in all such problems, the highest efficiency can be secured only by knowing accurately the conditions with which the engineer has to deal and the ends he must secure. Is the theory upon which we base our practice in accord with the advance of knowledge during the past two or more decades? This is always a good question to ask and especially with regard to matters involving costly and often inconvenient building construction.

The old idea that the purpose of ventilation is to keep the air reasonably free from carbon dioxid and supplied with its normal content of oxygen, has long since been given up. Rarely does

the carbon dioxid rise to more than 50 or 100 parts in 10,000, or the oxygen fall below 19 or 20 parts in 100, and we have no reason to think that this, of itself, is responsible for the effects of poor ventilation. At the same time it is by no means proved that the quantity of oxygen available to the body or the effectiveness of the removal of carbon dioxid from the body are without influence, for it is the quantity and especially the tensions of these gases in the lungs and not the quantity in the air of the room which is the important thing. It is not impossible that there may be various reflex or psychic interferences with the normal working of the breathing mechanism which result in deficient or perhaps in the equally undesirable over-ventilation of the lungs. Fortunately, the introduction of Haldane's simple method of analysis of the alveolar air now renders this subject capable of comparatively easy investigation, and it is to be hoped that our knowledge about it may soon be materially extended.

The failure to make the composition of the atmosphere in oxygen or carbon dioxid responsible for the results of poor ventilation led to the theory that the cause of the trouble is the presence of minute traces of extremely poisonous material in the expired air, and it was furthermore assumed, with utterly inadequate proof, that these poisons come from the lungs. Hence the teaching that while the carbon dioxid of the expired air is not itself responsible for the bad effects, it may be used as a measure of the imponderable or undeterminable poisonous material. And so there have been made thousands of analyses of air for this gas in the endeavor to measure thereby the efficiency of ventilation.

Expired air unquestionably contains material not present in normal air and these materials often have a very offensive odor. But it is not true that they are contributed chiefly by the lungs. Decaying food particles in the mouth, catarrhal exudates, uncleanliness of person, and the like are far more responsible for their presence. If this is so, it is perfectly clear that the carbon dioxid is NOT a measure of their amount. A room crowded with typical representatives of the great unwashed, who do not brush their teeth and have never occupied a dentist's chair, would certainly impart to any assembly room a flavor which could not be

given by the same number of individuals of cleanly habits; and yet the carbon dioxid content of the two rooms would in all probability be identical.

Nor is this all. Even granting that these offensive substances are present, it is not proved that they are poisonous, or at least to what extent they are poisonous. The fundamental assumption of all such theories is that in the bad effects of poor ventilation we are dealing with some sort of intoxication, i. e., with the action of a poisonous material reabsorbed into the body with the inspired air. Good as this assumption may be to serve as a working hypothesis upon which to base accurate investigation, we may confidently challenge the production of any adequate proof that poisonous material in the inspired air is the sole or even the chief cause of trouble. In other words, even on the theory upon which it is based, this measurement of carbon dioxid is an example of "barking up the wrong tree," wasted effort which the exercise of a little common sense would have saved.

Nor is the teaching of physiology lacking in indications of other and certainly equally important sources of trouble. A crowded, badly ventilated room is almost always an overheated room with an atmosphere surcharged with moisture. The heat comes from the oxidations going on in the bodies of its occupants, and every breath of exp'red air leaves these bodies not only with an increased percentage of carbon dioxid and possibly other material of organic nature, but saturated with aqueous vapor. In other words, the atmosphere of the room comes to repeat the conditions of a warm, muggy summer day. Indeed, it only requires an appeal to experience to see that there is a suspicious similarity in the effects of the two condition upon the human organism. The importance of these atmospheric conditions is, moreover, enhanced when we remember that it is not the general air of the room but that in immediate contact with the persons of its occupants which exerts the physiological effects in question. The writer cannot but feel that if more attention had been paid to the physical condition of the air within a few inches of the body and less to the general air in the room, the practice of ventilation would today be far more efficient, simply because it would have coped intelligently with at least two of the main evils.

The treatment of the practical problem of ventilation as a portion of the applied physiology of respiration takes far too narrow a view of the subject, and indeed this is recognized in much of our practice. In technological schools, courses usually combine the treatment of the subjects of heating and ventilation. But do they not generally look upon heating and ventilation as two separate things, instead of being, as they really are, two parts of the same problem? Of course, in such matters all depends upon our definition of terms and we may confine our conception of ventilation, if we will, to the supplying of "fresh air" to an inhabited room. At the same time it is no uncommon occurrence to get wrong points of view because of the previous adoption of unfortunate definition. Ventilation as it is popularly understood, and as we think it should be understood, is not simply the replacement of vitiated by pure air; it is rather the maintenance of ideal atmospheric conditions in a room, the correction of all undesirable atmospheric conditions, such as the presence of offensive and possibly poisonous constituents, too high or too low temperature or humidity, contamination from leaky gas fixtures, the updraught from damp cellars, and numerous others for which the practical engineer must be on the lookout and which he must understand how to estimate with approximate accuracy. The practice of ventilation as an art is perhaps more a case of the applied physiology of temperature regulation and the circulation of the blood than of the physiology of respiration; it is far more a physiological than a toxicological problem; and, more than this, it requires practical knowledge of many factors of domestic and public sanitation.

The practical side of ventilation should also take account, to a far greater extent than it actually does, of the variable nature of the conditions with which it must cope. The maintenance of ideal atmospheric conditions in a climate whose mean temperature is 75° is an entirely different proposition from what it is in one whose mean is 65°; it is entirely different according to the relative humidity; and the problem differs, above all, with the variability in these conditions from day to day. Has there not been entirely too much rule of thumb in our practice? Every treatise on the subject gives tables of the number of cubic feet of air which should be supplied to hospital wards, to school rooms, to factories, and so on. Surely it must make all the difference in

the world in what sort of climate these buildings are located. Formulae are excellent things but only when they are judiciously applied, and a good formula for Boston may be a complete failure for Denver.

We may also point out that it is almost certainly a mistake to seek for any single convenient test of the efficiency of ventilation. It is, of course, not impossible that some test may be found which would give an approxmiate measure of this efficiency; but there certainly is no such test known today, nor is it likely that it will ever be discovered. The determination of carbon dioxid, as above pointed out, has been lamentably overworked. The operation of this test by a chemist sent from the office of a ventilating expert may at first impress the layman who knows nothing of its significance with a pleasurable feeling that he is getting the worth of the money spent in installing a ventilating system; but too frequently the same layman is found a year or so later expressing his opinion of "these scientific fellows" in language more picturesque than quotable, and he is usually justified in doing so. Efficiency tests should certainly include temperature and humidity, and the results of all tests should be interpreted in the light of accurate knowledge of the conditions to be dealt with. After all, the final test is the experience of the occupants of the room. If your tests say that the ventilation is perfect while those who try it in their own persons say that the room is "stuffy," then something is wrong with the tests.

There is in this whole matter a large field for the very best kind of scientific study. These are days in which the virtues of fresh air are certainly not underestimated and the experience of clinicians points unquestionably to hygienic value in fresh air, which is at times almost miraculous. And yet the whole thing is on a purely empirical basis. No one has yet given a satisfactory explanation of the action of fresh air in the treatment of tuberculosis; and, so long as this is so, we must be applying the therapeutic agent more or less unintelligently, perhaps at times extravagantly. Similarly with regard to ventilation. Is it not time that the basic physiology and sanitation of the problem were being thoroughly reinvestigated, so that the weak points in our practice may be detected and the best results most inexpensively secured?

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DAMAGE SUITS FOR TYPHOID FEVER.

The California State Board of Health Bulletin for October contains this statement: "The time will come when citizens will sue a city for damages resulting from typhoid fever, concerning which the city gave no warning, just as they now sue for damages resulting from a fall into a city excavation over which no warning lights were placed."

At first thought this sounds rather absurd, but a test case would bring to light facts which would cause the city's attorney some anxiety. There are few people in whom the following story does not stir some memory of a friend.

"John Doe died yesterday of typhoid fever. He leaves a young wife and two small children. The city, as well as his family, has suffered heavily in the loss of this influential young business man, who has been prominent in the important work of the Civic Improvement Association. His death was caused by milk from an infected dairy, and the citizens are demanding the re-establishment of milk inspection, which was quietly discontinued last spring by the trustees as a measure of economy."

What about Mrs. Doe and the two children? John Doe was twenty-five years old. He carried $10,000 life insurance and was receiving a salary of $1,800 a year. Both the life insurance companies and the wife had every reason to believe that he had at least 30 or 40 years of active business and civic usefulness before him. Even if his salary were not to be increased, his earnings thus cut off represent from $54,000 to $72,000. His $10,000 policy was a large one for a young man on a small salary, but still it was manifestly poor business for him to die. Just suppose this young wife should sue the city for $60,000 damages on the ground that the city had voted funds for a proper control of the milk supply and that the council had diverted these funds to other uses without warning the citizens. What would the verdict be? Arguments introduced to show that a city can not ensure safe milk to its citizens could be controverted by evidence from cities that have done it. Arguments showing that this young man might have died shortly of some other disease would

be no more valid in this case than in hundreds of successful damage suits against cities for deaths from accidents due to municipal carelessness.

The time may never come when such damage suits will be filed, but it will not be because they are less logical than suits for accident damage. The records of most typhoid fever outbreaks show that not more than one out of each ten cases dies, but the remaining nine who recover suffer heavy losses. Few typhoid fever convalescents find their expense has been less than $300, counting fees for doctors, nurses, drugs, and possibly loss of wages. Any person can estimate for his own community what typhoid fever has cost during a series of years. The citizens of the majority of our states are spending collectively upwards of $2,000,000 or $3,000,000 annually for this one disease.

There is probably no way in which an efficient public health administration could be established more promptly than by the institution of a series of prosecutions for gross neglect of municipal health protection.

The chance illustration of typhoid fever infection through contaminated milk could be paralleled by costly epidemics due to many other agencies for the transmission of the typhoid bacillus (polluted water supplies, sewage-irrigated vegetables, unscreened fly-infested toilets, typhoid carriers).

The history of "Typhoid Mary" is tragic and very naturally excites our sympathy for Mary, but a careful judgment between the right to liberty of the "Typhoid-Marys" and the right to protection from typhoid infection of their many victims must favor the victims. The restriction of liberty of the individual as a measure of protection to the public is an unquestioned practice in all diseases which the public fully believes to be dangerous. This is true of the innocent leper, the unfortunate insane, the harmless imbecile, even the unsightly deformed in many countries. Typhoid fever patients and carriers are far more dangerous to their fellow-citizens than any of these, but the public does not realize this. Many physicians even do not realize it to the extent of instituting effective precautionary measures in all typhoid fever cases.

Until the public is fully awakened to the business importance and practicability of public health protection, the old order of

things will not materially change. This awakening has begun and will go forward with accelerating speed. The educational movement for health conservation is about to be supplemented by practical application in representative communities throughout the United States.

As people become better informed on these matters they will begin to ask questions when their neighbors become ill or die from some preventable cause. They will vote money to build fortifications against the invisible armies of disease just as they now vote money for protection against human foes. Adequate provisions will be made for a standing army of sanitarians and a public health militia.

It will take time for the majority of American voters to realize that for the protection of our lives plate glass in our tenement houses is more important than armor-plate in our sea-walls; that sanitary officers must be equipped with microscopes and a laboratory, as soldiers are with guns and powder magazine; that a public health militia requires training in the use of soap and water, sunshine and fresh air—their form of military tactics. But every student of current events must recognize that the irresistible movement for health conservation which is now sweeping over the country will eventually bring these things to pass.

Today the surgeon whose operation is followed by infection is expected to explain satisfactorily how it happened or face a suit for damages. This has come about through the careful application of "preventive medicine" principles to the environment of the patient during the period of the surgeon's responsibility. These same principles of prevention of disease may be applied just as effectively to the environment of a community. But it must be remembered that the surgeon only assumes responsibility under known conditions. He requires a trained nurse, the equipment of a hospital, his patient's compliance with every detail of his instructions. The specialty of surgery is as old as the history of scientific medicine, and the people appreciate and respect the advice of the surgeon.

Public Health is also a specialty in medicine, but there are few physicians fully qualified to practice it, and the people have only recently begun to learn its value. Slowly the idea is being

grasped that just as there are many diseases known as "surgical," in which the general practitioner desires the advice of a surgeon, so there are many diseases known as "communicable," in which the general practitioner should ask for consultation with a public health specialist. As this idea gains ground it becomes apparent that to be of real service to the general practitioner and to warrant his respect the public health specialist must prepare himself as does the surgeon, by special study and wide experience. A general practitioner with a political appointment as health officer in his pocket is not a public health specialist likely to inspire respect and hearty co-operation from his fellow practitioners. When the public has studied these things out, adequate salaries will be voted for retaining the services of practical highly trained specialists to protect the public interests in all cases of communicable diseases. It will be their duty to serve as consultants to the general practitioners, and there will be no criticism attaching to the physician's care of his patient when the public health specialist requires certain measures carried out which are of no importance to the patient but are of vast importance to the public welfare.

The military point for attacking the typhoid fever bacillus lies at the bedside of the patient. The lack of appreciation of this strategical fact by the attending physician is shown whenever the care of a patient is entrusted to "practical" or novitiate nurses whose inexperience permits the daily escape of typhoid bacilli from their patients. Every health officer knows physicians in his community who make guess-work diagnoses and who are not qualified to issue adequate instruction concerning the protection of the public from their typhoid cases. And yet the health officer may only suggest to these physicians that he would gladly come in as public health consultant, make blood and urine and other examinations in any continuous fever case, and supervise the necessary measures of prophylaxis—suggestions which are rarely made and more rarely accepted. The health officer is still further limited by false medical ethics which hold him silent before recognized incompetency of physicians in charge of communicable diseases. The result of all this is that the public health officer, instead of beginning an active scientific fight at the bedside, must wait on the outside of the house and

guess what particular avenue of escape the invisible enemy is going to find open to it.

The recognition by both family and general practitioner that the trained public health officer is of the same value as a consultant in communicable diseases, as is the surgeon in surgical diseases would enormously increase the efficiency of public health work. It remains to be seen whether the general practitioner will lead in the creation of this new specialty or whether he will be forced by an educated public to recognize it and to do his duty in co-operating with its representatives. So long as practicing physicians who have neither experience nor native ability for public health work are willing to accept the responsibility of the public health office, so long will an uninformed public continue to limit its appropriations to a salary of ten to fifty dollars per month and refuse to provide laboratories or to comply honestly with regulations which displease them.

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IS HOUSING REFORM WORTH WHILE

Employers of unskilled labor are constantly and with reason inveighing against its inefficiency, its intemperance and unreliability. The charge is not a new one but, with the increasing congestion of our population in cities, it has been made with greater frequency in recent years. The man on the street, if he thinks at all of its cause, is very sure to attribute it to intemperance, without realizing that this in itself is symptomatic rather than causative. Men get drunk because they are undervitalized and ill nourished much more than for any other reason and intemperance increases and emphasizes the causes of their inefficiency.

We have ceased to attribute disease to a mysterious dispensation of the Almighty and we lay the blame, or a large share of it, on filth of one sort or another. We are very insistent that our water and milk supply shall be uncontaminated, that our food shall be pure and that flies shall be kept away from it, and we talk almost hopefully of the ultimate annihilation of tuberculosis, of typhoid, of smallpox and other diseases.

Social workers and sanitarians have for many years recognized the analogy between shiftlessness and poverty, vice and crime on the one hand and disease on the other, but such has been the influence of the individualistic philosophy and theology that the idea of a social causation for social ills has been of very slow growth. Only within a comparatively few years has it been realized that a man born of an undervitalized mother, living all his life in unsanitary and immoral surroundings, put into the factory at ten or twelve and constantly under-nourished, has very little opportunity for developing efficiency and that for him the doctrine of free will and individual responsibility becomes very tenuous.

All of these debasing factors deserve careful study and chief among them the conditions which surround him in his home, for there he passes nearly, if not quite, half of his lifetime, and there, as a rule, he is subjected to conditions of insanitation far worse than those in the factory or on the street. It is there that we must look for most of the incidence of disease. Squire and

Hulbert, after a careful study of conditions in London, reported to the International Congress on Tuberculosis that "among the poor the source of tuberculosis must generally be sought in the home rather than in the workroom or the street." The death rate of the entire city of London is 15.6 while that of the worst slum districts runs from 40 to 50. Lagneau has shown, from statistics collected from 662 cities in France, that the denser the population, the greater is the number of deaths from tuberculosis; the death rate being, in cities of 5,000 inhabitants, 1.81; in cities of 20,000, 2.71; in cities of 100,000, 3.05; in cities of 450,000, 3.63; while in Paris the death rate is 4.50.

The Medical Officer of Health of London reported in 1898 a similar condition in that city. In districts where there was less than 10% of overcrowding the death rate was 1.10; where there was less than 25%, the rate was 1.80; under 35%, the rate was 2.42, and over 35%, 2.63.

The experience of British cities, while recruiting for the Boer War, is significant as showing how congestion tends to physical degeneration, Manchester, for example, being obliged to reject, as physically unfit, 8,000 out of 11,000 applicants. Glasgow, a city where 87% of the population live in houses containing three rooms or less, took the physical measurements of 72,857 school children and classified their height and weight in correlation with the number of rooms in the houses in which they lived. The results were most striking. The average height of boys whose families lived in one room, was 46.6 inches; of those who lived in two rooms, 48.1; three, 50 inches and four or more, 51.3. The average weight increased in the same way from 52.6 pounds to 64.3 pounds.

The influence of unsanitary housing is twofold; first, by reason of the fact that the dwellings, having insufficient light and air, permit the indefinite preservation of pathogenic bacteria; and second, the unsanitary conditions induce an anemic condition of the body and render the individual, subjected to its influence, incapable of vigorous labor, prone to the use of artificial stimulants and markedly susceptible to disease.

In quite as serious a way, bad housing reacts on the moral constitution of the tenement dweller. Almost invariably these conditions cause a weakening of the moral fiber and a loss of

ideals. Crowded together three and four in a room, modesty is next to impossible, and cleanliness a work of supererogation. The situation is still further complicated by the frequent, if not general, practice of attempting to reduce the high cost of rent by the introduction of the lodger into the family, with results almost invariably pernicious.

Under such conditions, it is futile to expect that there will be very much of home life. The father escapes to the saloon, the boys to the street and the girl to the cheap theatre and the dance hall. The wonder is, not that the result in drunkenness, in prostitution and in crime is as bad as it is, but that it is not worse.

Our American cities are just beginning to wake to a realization of what these conditions mean and will mean. New York has been struggling with the problem for years and more recently Philadelphia, Chicago, Pittsburg, Louisville, St. Louis, New Orleans, Los Angeles and Washington have undertaken investigations along these lines, in an attempt to determine a future policy. Conditions in each city are individual and the problem must be solved by each in its own way.

Legitimate property interests must be conserved but as Letulle so well said before the International Congress on Tuberculosis, "The right of property must not be carried to the extent of legalizing an attempt on the life of one's neighbor."

Even in our newer cities, conditions, which are now more or less sporadic, are becoming each year more general and the longer that a radical revision of their building laws is postponed, the more difficult will be the task when it is at last attempted. The slum is inevitable unless it is prevented by well enforced legislation. It needs no legislation to create it.

High tenement buildings are no necessary mark of the slum. Its constituents are more frequently the small family dwelling house transformed for multiple occupancy, the cottage in reduced circumstances, or the shack thrown together out of waste materials. The sleeping room which has no direct connection with the light and air, the unsewered privy vault, the surface well, generally close beside it, the cellar apartment, are so common in our younger cities as almost to escape notice, while in our older towns, although they may be free from some of these evils, have conditions of overcrowding which make the problem a most

serious one. The sublime confidence with which a builder will erect a building the full width of his lot, trusting that his neighbors on either side will not do the same, is more remarkable than praiseworthy and that his confidence is misplaced is evidenced by the existence of very numerous examples of buildings where only such rooms as front on the street or the yard receive any direct light and air and the others depend on a scant supply which may filter through a grimy window and a dirty room.

It is an old and quite gratuitous slander that the poor do not appreciate sanitary surroundings. The fact, which will be testified to by everyone who has had personal experience with them, is quite the reverse. But whether they do or they don't, the state and the city, from motives of self preservation, if for no other reason, ought not to permit its citizens to live under such conditions for, in inefficient labor, in the budgets of hospitals, asylums, reformatories and prisons, in the contagion which, starting in the slums, does not stop there, Society sooner or later pays the bill.

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COUNTY OFFICERS OF HEALTH.

Since the enactment passed in England in 1847, in Section 12 of the Towns Improvement Clauses Act, to the effect that the Commissioners in any local district may "if they think fit," appoint a person of competent skill and experience who shall be styled the "Officer of Health," till the present, the evolution of the medical officer of health has been the most accurate measure of the development of Public Health as a function of government, and as the illustration of social advancement. The telegram sent at the same moment as King Edward pressed the button in England, which opened the new Tuberculosis Dispensary in Montreal in October, 1909, stated that as the pressure of the button which opened the doors, turned on the electric lights and unfurled the Union Jack, showed the marvellous progress of science, so he did not doubt that the same scientific progress would be shown to be equally applicable and effective in the field of preventive medicine.

Everywhere the work to be done by the medical officer of health is now being recognized and the methods of doing it have in large degree been elaborated; but the manner of its execution is that which urgently demands our serious consideration. The last word said on the subject in England is in the clause which the Hon. John Burns, President of the Local Government Board, insisted upon last year, even against the House of Lords' amendment, that County Officers of Health should give all their time to the office and that their tenure should be permanent. This point, however, has been reached very gradually. Not until 1872 was it made compulsory that each urban and rural authority should appoint an official to be known as the Medical Officer of Health; but there was nothing stated as to the extent of his duties, his permanency or his salary. Not till 1888 was the next real step taken, when there was a general reorganization of municipal government, resulting in County, District and Parish Councils, the first advanced step since 1839 which first gave local government, as we understand such, to the people of England. The need and reasons for this development were obvious. Tiny

industrial towns as in Lancashire and the Midlands had grown in a generation into populous centres, slums had grown up around insanitary factories; "trout streams were converted into foul sewers and every open space was a rubbish heap."

What has happened in England has within a quarter of a century taken place on this Continent with even more startling rapidity, and those who have watched the growth of population and the increase of cities, the enormous development of industries and the growth of a complex urban social life, are today anxiously seeking for machinery adequate for dealing with the health problems confronting us. Investigations in scientific laboratories, whether University, State of Provincial, or in those of the great industrial corporations, have provided an abundant knowledge to guide us in our operations toward protecting the public health; but the people through their Federal, State and Municipal governments have not as yet supplied the administrative machinery by which we can effectually bring such knowledge to bear on public health problems. What we are needing is what England has at last arrived at—a system of District or County Officers of Health, standardized as to their scientific knowledge by a degree in Public Health, paid sufficiently to devote their whole time to the Public Service and protected in their duties by the application of the Civil Service code of permanency of tenure in office. There is no need to argue this point today, since everywhere both in the United States and Canada, as well as in England and elsewhere, it has become apparent that scientific progress means specialization in any field of work, and the supply of workers is dependent upon permanency of employment and adequate remuneration.

We shall therefore concern ourselves only to enquire how this is to be brought about in practice. In England, in Canada and in most of the States there have grown up, side by side, dependent largely upon density or sparseness of population, two fairly distinct municipal systems, illustrated by Bryce in his "American Commonwealth," as the "county system' illustrated in Virginia where large plantations existed, and the "township" system of New England which grew out of the old town meeting. Some provinces and states have, however, both systems as in England, the larger area having originally relegated to it such matters as

highways, justice and secondary education, while many other matters, especially health, were local parish or town matters. But since public health has become a serious study, demanding the application of exact science, students of Public Health problems have been seeking on this Continent the remedy found in England of so uniting the public health units of a number of smaller districts as that the cost to the ratepayers for a permanent and efficient public health service shall be minimized. It is apparent to all officials, whether municipal or state, who have had practical experience during the past twenty-five years, that until this consolidation has taken place no further local health progress is generally possible. In many states this consolidation has long existed in primary education. The Counties appoint qualified inspectors of schools who, in some provinces at least, are paid by Provincial "grants-in-aid," as in England, up to 50% of the salary. In Public Health matters the greatest advance which the writer is aware of on this Continent is where the state or province encourages efficiency by one or several state medical inspectors, investigating local epidemics or advising in matters of public water supply and sewerage.* But in a Province as old and as municipally advanced as most on this Continent, the writer has for twenty years proved fully the inadequacy of the seven hundred or more local township, town and village Boards of Health with as medical officer a local practitioner competing with his medical rivals, paid from nothing to $25.00, $50.00 or $100.00 a year, for doing mostly nothing and, if charging fees during an epidemic for special services, almost invariably having his bills questioned or refused, and if he forced payment being dropped with loss both of money and prestige.

The remedy suggested by the writer many years ago is simply that system applied partially in England, but effectually applied in Canada in primary school work. It is that of a County Med-

* Massachusetts, in 1907, passed "An Act to provide for the Establishment of Health Districts and the Appointment of Inspectors of Health." There are fifteen Districts and fifteen Medical Inspectors "learned in the science of medicine and hygiene," appointed by the State Board for five years, but liable to removal from office by the Governor and Council at any time. The salaries are to be paid wholly by the State, but as only $25,000 was voted, it will mean that Medical Inspectors will not give all their time to the work. This, with the limited time of the appointment and the power of removal at any time through political influence, greatly lessen the value of what otherwise marks a great advance in Public Health administration.

ical Officer of Health, with a public health diploma from some University Medical School of recognized standing in his State or Province, to be appointed by the County Council, and who shall receive an adequate salary and devote his whole time to public health work. As it is the question of the cost which will be the primary difficulty, the plan apparently most applicable, at any rate to Canadian practice, will be for a percentage, say 50% of the salary, to be paid by the State or Province through the State Treasurer on the Certificate of the State Board of Health, that on the one hand the initial salary paid by the County is adequate, when supplemented, and on the other that the County Officer is performing efficient work. The tenure of office would be permanent, every officer, however, being subject to investigation under the General Law relating to Official Investigations in any State or Province. Dependent, of course, upon the density of population, the area for which such an officer would be appointed would be roughly one having from 20,000 to 30,000 population, including towns and rural areas. Commonly in Canada the area for which a member of the Provincial or State Legislature is elected, would prove a practical unit. As in the older States and Provinces, these areas are within the boundaries of a County, it makes the application of the Municipal County System easily possible.

To lend dignity to the office and maintain its work in close relationship with the county organization, a County Board of Health, to meet quarterly or more often in emergency, should exist, to be composed of the Warden or elected head of the county council, ex officio, and either the senior or junior county judge, along with the medical officer. Such a Board, composed wholly of officials, would add nothing materially to the cost, while questions of health, finance and law would have brought to them the experience of men trained to consider each. The health machinery would of course be: (a) The laboratory, required to have a minimum of equipment supplied by the county, satisfactory to the Provincial or State Board, located centrally and convenient to the work by both rail and telephone; (b) In those counties where some institution as a county tuberculosis hospital or sanatorium existed, it would often be found of real practical utility to have the medical officer placed in charge, have

the laboratory there, and so centralize and enlarge his work; (c) As the county contains a number of townships, towns and villages, which may have already a sanitary officer, these would become as in England automatically the local officers of the County Officer, with duties defined under the law, such as reporting daily when necessary all notices of contagious diseases, and carrying out routine inspection, disinfection and policing; (d) The medical officer would similarly receive directly from physicians, or through the local inspectors, reports of outbreaks of contagious disease, and from all practicing veterinarians notice of contagious disease in animals, affecting the public health. (e) The medical officer would similarly be medical inspector of the schools of his district, and would naturally carry out the physical inspection of the school children, as well as the inspection of school buildings and the control of contagious diseases. (f) He would also put into force a systematic supervision, not only of the factories in towns, but especially of the rural factories as of cheese, butter and fruit canning. (g) He would likewise systematize, through the township inspectors, the examination of dairies and the supervision of public milk supplies. (h) He would especially through local veterinarians discover herds where tuberculosis existed, and would gradually organize a meat inspection service through centralizing the slaughter of meat to be sold to the public.

Since the practice is rapidly developing of having in county areas at least one sanatorium for cases of tuberculosis, whose management will naturally come under the county medical officer, and as no more convenient or necessary means can be found for a County Officer keeping in touch with the local medical profession than a laboratory, where in addition to the routine examination of swabs, sputum, etc., he can examine pathological specimens by definite arrangement, it is evident that an amount of work properly belonging to a County Officer has been outlined, which, if performed, would entitle such officer to the position, which a Medical Officer of Health should hold, as the most elevated and important office in any community.

In Canada, where an old-time practice has existed of appointing as many coroners as there are medical men caring to make application, an anomaly exists where the coroner's "quest"

often approximates a scientific farce. A dead body is found under suspicious circumstances and a post mortem is ordered, and at times carried out by some practitioner who probably has made no post mortem since his college days. Were a Medical Officer of Health for the County appointed, with the duties of medical examiner in legal cases as a part of his duties, the State would be assured of having this most important work done on scientific lines.

The progress of Municipal Public Health work, remembering how there was no scientific basis for much of this work as regards a knowledge of the causation of disease until thirty years ago, has been more rapid by far than that of primary education; and today when, apart from the humanitarian side, the economic value of a human life to any community is beginning to be realized, it is a matter of certainty that those larger methods of organized co-operation so necessary in epidemic work, the control of food supplies and industrial operations will soon result in machinery whose effectiveness can even now be seen on every hand.

PETER H. BRYCE, M. A., M. D.

[Chief Medical Officer, Dep. Interior, Canada.]

SPECIAL ARTICLE

A METHOD OF SEALING TEST TUBES TO PREVENT EVAPORATION OF CULTURE MEDIA.

By W. L. BEEBE,
Bacteriologist for the Minnesota Live Stock Sanitary Board.

Many times it is advantageous to store a considerable quantit y of culture media in test tubes. As it is very hard to keep it for any length of time without evaporation, the writer tried several methods of sealing the tubes. Most of the methods that were tried were found to be more or less faulty and did not prevent evaporation absolutely. Finally, a method was devised that has proven very satisfactory and has been used in this laboratory for the last three years.

It consists of a square piece of glass covered with sealing wax pressed down on the top of the tube while the tube is hot enough to melt the wax. In the writer's experience the best results were obtained by the following procedure: the glass sealing wax caps are easily made by cutting window glass into squares of from three-fourths to one inch. These are thoroughly cleaned and dipped into very hot sealing wax, thus covering them evenly. They are then dropped into a dish of cold water which cools the wax before they reach the bottom of the dish so they do not adhere to one another. Bacteriological test tubes which are thicker than the ordinary tubes should be used. It is desirable to use tubes without a lip because thin tubes are frequently broken in removing the cap. It is advantageous to have the top of the tube ground if the edge is uneven. The cotton plug should fit rather loosely so that they can be flamed and pushed down just below the mouth of the tube. The tube is then heated sufficiently to melt the sealing wax where the rim of the tube comes in contact with the wax. The glass sealing wax cap is firmly pressed down upon the mouth of the tube and held

in position for a few seconds and then placed in an upright position in a test tube rack until they have cooled. Tubes that have been sealed by this method have been kept in this laboratory for over three years without evaporation.

The caps are easily removed by tapping them on the underside with some instrument, such as a scalpel. Usually a small amount of wax will adhere to the mouth of the tube, but this is easily removed with a scalpel. The plug is then drawn up in position with forceps. If any sealing wax is present on the plug it is usually advantageous to flame the tube and turn the plug around in the tube two or three times while the tube is cooling. If this is done the sealing wax on the plug will be of no disadvantage. The wax is easily removed from the used tubes by putting them in chromic acid cleaning mixture for a few hours.

American Public Health Association

AGE PROBLEMS IN INDUSTRIAL HYGIENE.*

By OWEN R. LOVEJOY,
General Secretary, National Child Labor Committee, New York City.

Those interested in the social phases of industrial improvement certainly appreciate the opportunity given by this Association to call to the attention of your distinguished body some of the facts gleaned in a field investigation of these conditions. It is my purpose briefly to outline a few points at which our work enters the same field and to ask your interest and co-operation in making the work of such organizations most effective.

One factor fundamental to all the work of organizations interested in children industrially employed can be supplied only by the active co-operation of public health officials, namely birth registration. It is a notorious fact that in large sections of this country no laws requiring a record of birth are operative, while in many sections of the country having such laws the facilities for their enforcement are so unequal to the task that but faulty records are secured. Even in New York City, where the law is unusually advanced and its enforcement administered with unusual efficiency, we are told that it is far more difficult to get age records of children born in that city or in other parts of our country than of children who come from Italy, Poland, Bulgaria, Spain or other European countries.

The relation of age to industrial employment is so obvious that discussion should be unnecessary. Nevertheless, we meet constantly an ignorant or indifferent public which assumes that adult burdens may properly be borne by children of any age, provided they are made proportionate to the child's size. Public health officials and physicians can do more than any other group of officers to make evident that certain periods in childhood are

*Read before the American Public Health Association at Richmond, October, 1909.

extremely critical, in view of the revolutionary physical changes occurring between the 10th and 16th birthdays. Probably not even the days of infancy are more hazardous than these.

For this reason the occupation of such children should be carefully guarded, especially from the standpoint of physical development. Whatever jeopardizes the health or physical efficiency of the child places so heavy a handicap on the future, whether from the educational, moral or economic view, that its conservation is fundamental. Children of the age mentioned should have something useful and inspiring to do, and the work in which the National Child Labor Committee engages is not an attempt to promote the idleness of children. On the other hand, it is our aim to so guard the years of childhood and early adolescence that when children come to the age at which industrial burdens of any importance can reasonably be borne, their bodies and minds are fitted for the burden. The present process of pushing them into economic employment for profit at the early age customary in many sections of the country is wholly unscientific.

It is unfortunate that no authoritative statistics can be furnished, as in older civilizations, to give an accurate chart of the social liability we incur through premature employment of children, or through employment of youth in industries entirely unfitted for any save adults. A Bulletin has recently been published by the Bureau of Labor, compiled by one of your members, Dr. Kober, which is the best study thus far made on the subject in this country. In the bulletin the author deplores the fact that statistical information is so meager. It is to be hoped that through the establishment of the proposed Federal Children's Bureau, so thorough and systematic a study of this subject may be made that we shall have a truly national basis for action. In default of any such government standard, it obviously rests upon local physicians and health officials more than on any other group of citizens to make public the serious nature of the forms of child employment that predominate in many localities.

A more dramatic phase of the relation of age to employment appears in a study of accidents. So far as the meager statistics in various states give evidence, it appears that children 16 years of age and under show almost uniformly a higher percentage

than adults in the same industries. This is true not only in coal mining operations, where the hazard is palpable, but in the general run of industrial occupations coming under the supervision of factory inspection departments. This is due not only to the physical frailty of the child, who lacks power of resistance, but chiefly to the mental characteristics of youth. Children are careless of danger and expose themselves to perils the adult will avoid.

We have for years spent millions in the building up of our army and navy and police systems, in the development of penal and reformatory institutions, sanitoria and health resorts, for the protection of society against foreign enemies and for curing those who fall victim to disease, but thus far our people have been extremely conservative in their meager appropriations for the preservation of the public health. In my judgment the present agitation against tuberculosis, typhoid and other preventable diseases is so emphasizing health considerations, that within the next decade we may expect the local health authorities to become the real important branch of our state and local governments. So important a field requires the skill and devotion of the very highest type of our citizens. That the present importance of this work should be more keenly appreciated, let me urge that local boards of health, or associations of local physicians, shall vigorously push a campaign to secure power to weigh and measure all children in the community whose physical condition is not adequately supervised by the public school.

The inappropriateness of many industrial occupations for children is now pretty well recognized throughout the country, but up to the present time occupation in agriculture has usually been looked upon as a form of employment free from danger and promotive of the highest interests. Recently, however, our attention has been called to sections of the country in which truck gardening and the preparation of fruit for canning and preserving offer so serious a menace to the health and morals of children as to require careful consideration and regulation. Perhaps the most startling arraignment of agricultural conditions thus far made is by Dr. Charles Wardell Stiles, of the United States Public Health and Marine Hospital Service, who,

together with his associates, has been making a study of the hook-worm disease in Southern agricultural communities.

Doubtless many of the irresponsible magazine writers, always eager for sensation, have embarrassed Dr. Stiles and his fellow workers—as they have wronged us—by persistently contrasting the hook worm with the cotton mill. They picture the cotton mill as a blessing to the germ-cursed millions of the South and intimate that when all facts are known, child labor advocates will see the wrong they have done Southern children by seeking to exclude them from the mills. I confess it is a little difficult to follow their argument. One hundred years of experience in textile industry in England and many years' experience in this and other countries have produced evidence convincing to leaders in the medical profession that child labor in textile mills is injurious. The claim is even made that for strong, healthy, well nourished children, the textile mill is detrimental, that the long hours, moist atmosphere (particularly in cotton mills) and eye-strain in many departments are a menace. Yet we are now asked to believe that children diseased, poorly fed, half-clad, whose vital organs and life blood are being sucked away by the hook-worm, are benefited by the long hours and hard labor of the cotton mill.

The contention that the cotton mill is the only alternative to hook-worm is not borne out by the teachings of Dr. Stiles. He claims that from 15c to 75c worth of medicine will cure the disease. If this is true, the cash outlay is certainly a more economic investment than the dedication of twelve year old boys and girls to a twelve hour day or a ten hour night in a textile mill. Investigations of hook-worm show that it is perpetuated and propagated chiefly by soil pollution. Valuable instruction is given by Dr. Stiles and others for the purification of soil in the vicinity of dwelling houses and for the proper construction and care of sanitary toilets, where adequate sewerage systems are not available. If there were a guarantee that every family from the sand barrens who moved into a cotton mill village would follow these instructions implicitly, the hope of curing the disease by migration would be increased; but everyone familiar with such communities knows that not over one per cent of the people literally follow the instructions of Dr. Stiles and other sanitary

experts. If the disease is due to soil pollution, what guarantee have we that in ten years the ground of the cotton mill villages will not be as foul as that in the vicinity of the old farm-house in the hills? Should it become polluted, we shall face the necessity of curing hook-worm disease in a mill population which, although better housed and better fed than formerly, will lack the resisting power of those who live in the open air.

The present situation with regard to this subject is extremely unfortunate. Every person in the South interested in the factory employment of little children is today quoting the statements that purport to come from these Government officials, but which doubtless in reality have come from the publicity experts of popular periodicals, as a defence of the exploitation of the little child. That due regard should be given to interests of primitive communities is recognized, and in many instances families who migrate from their remote cabins in the sand hills to the newly built cotton villages, find the economic necessities of the new environment extremely hard. The low standard of wages in many of these mills lays a heavy burden on the family purse and one can readily understand the eagerness of the parent to utilize the frail services of infant hands to eke out the family income. But that the employment of tender children for a ten or twelve hour day is a necessity in that or any other part of the country, is emphatically denied. The time has come when the standards of our country must indignantly repudiate the principle that our industrial progress and the domestic independence of our people are built on such a foundation. Frankly, it puts the manufacturers who defend this child employment in little better light to follow their line of excuse for child labor. Science and experience taught that factory labor tends to make children pale and to interfere with their physical development. Now we are met by a class of practical economists who tell us that instead of making children sick in their factories, they are engaged in the employment of sick children.

If conditions of farm life are as much worse than conditions in the cotton mill as we are led to believe, we have a two-fold reason for a most persistent, vigorous campaign of education in sanitary reform. Instead of appearing as hostile, there should be the most cordial and intimate co-operation. I bespeak the

representatives of the National Child Labor Committee in saying that we welcome all information that can be gathered regarding abuse or neglect of little children anywhere, and so far as that abuse or neglect relates to or may be affected by their industrial occupations, we stand ready to use all our efforts in their behalf.

The standards of regulation endorsed and actively promoted by the National Child Labor Committee may be briefly summarized as follows:

(1) A fourteen year age limit for all industrial occupations.

(2) Beyond this a careful scrutiny of the physical and educational development of the child, on the theory that physiological and mental age development are far more important than a mere chronological record.

(3) The protection of all children sixteen years of age and under, which shall include:

  (a) Exclusion from all occupations dangerous to life or health.

  (b) Prohibition of night employment.

  (c) Restriction of the hours of labor to an eight hour day.

Beyond this we recognize the importance of guarding the moral interests of our communities to the extent of still further regulating the employment of those engaged in industries that involve a hazard to the moral life. Among these may be mentioned employment in night messenger service, which in time will doubtless be forbidden to all minors.

The National Child Labor Committee is a voluntary organization of citizens representing all parts of the country and seeking at this one point to defend the American child. We do not attempt enforcement of the law or an exhaustive accumulation of statistical information. On the other hand, we aim to co-ordinate the interest of intelligent citizens and furnish moral and political backing, so essential to the effectiveness of the work of public officials. In the name of this Committee I desire to pledge your association our utmost efforts to make effective the advanced standards for the preservation of the public health, which are the basis of your activities and lie at the foundation of our Commonwealth.

THE PROTECTION OF FACTORY EMPLOYEES AGAINST DUST ARISING FROM CERTAIN OCCUPATIONS.*

By WILLIAM C. HANSON, M. D.,
Cambridge, Mass.

Massachusetts has two laws relating specifically to the protection of employees in factories and workshops against dust which is generated in the course of manufacturing processes or which is caused by manual occupation. These laws are enforced by the State Inspectors of Health under the supervision of the State Board of Health. One law provides that if it appears to a State Inspector of Health that the inhalation of dust caused by any manufacturing process would be "substantially diminished without unreasonable expense by the use of a fan or by other mechanical means, such fan or other mechanical means, if he so directs, shall be provided, maintained and used." The other law provides that emery wheels and belts and buffing wheels and belts shall be equipped with hoods, suction pipes and fans or blowers; that the fans and blowers installed shall be of proper size and run at effective speed, and that the pipes and connections shall be approved by the State Inspectors of Health. The only grinding machines and emery wheels to which this law is not applicable are the "grinding machines upon which water is used at the point of contact" and "solid emery wheels used in sawmills, in planing mills or in other woodworking establishments," and "emery wheels six inches and under in diameter used in establishments where the principal business is not emery wheel grinding."

In guiding the inspectors, the first point upon which stress is laid is that the emphasis of danger in relation to a given industry should be placed where it belongs. For practical purposes the inspectors are taught to classify all conditions which arise from an industry which directly endanger the health of the employees into three groups: (1), those which are avoidable; (2), those which are to a certain extent avoidable; and (3), those which are

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entirely unavoidable. In this way the problem of determining to what extent it is practicable to render harmless dust or other impurities injurious to health is made much less difficult, while the opportunity for an inspector to fall into the error of requesting manufacturers to make changes which they cannot reasonably be expected to make is practically eliminated.

The textile industry employs a larger number of persons in its factories than any other industry in Massachusetts, and the majority of employees are women and minors. Associated with the cotton industry are dangers which are direct and obvious in their effects upon the health of the workers, and for this reason the manufacture of cotton goods has been considered a dangerous trade. In justice to the industry, however, and to those manufacturers who are progressively attacking, from a commercial point of view, the very problems which go hand in hand with improved hygienic conditions, it seems to me that we might very properly lay more emphasis upon the avoidable dangers which, if removed, will go far toward taking the cotton industry from the list of "dangerous trades." The fact that the work of cotton mill employees involves more or less constant confinement in a dusty atmosphere cannot, of course, be overlooked, even in the best regulated fine grade goods mills; but a careful consideration of other factors than cotton dust which affect injuriously the health of the workers shows that too little thought has been given to the evil consequences of poor light—especially in certain departments—excessive heat, nauseating odors and irritating gases, the products of gas combustion, the lack of proper means of ventilation, and the failure to regulate properly the introduction of artificial moisture, and want of cleanliness.

Poor light—itself a factor of no mean consequence in reducing the physiological resistance to disease—may be a concomitant of a number of other unsanitary influences, as for example, in the weaving and spinning rooms, or it may be the principal factor, as in web drawing. Even in a weave room, it is possible that the injury to employees caused directly or indirectly by insufficient light is as great as that due to dust, which in this department is generally slight in amount. Add to poor light, unnecessarily high temperature and excessive moisture, want of cleanliness and lack of provision for a plentiful supply of fresh air, and we have

a most important group of conditions to deal with which are very largely avoidable. Again, in the ring spinning rooms there are avoidable objectionable conditions common to most cotton factories in addition to the cotton dust or "fly," which in this department varies from a slight to considerable amount.

In short, the presence of dust in the air of cotton workrooms does not appear to be a prominent feature in its influence on health except in the first few processes which cotton undergoes after being taken from the bales. That is to say, the intrinsic danger in the industry, practically unavoidable at the present time, lies chiefly in the opening, picking and carding processes, the danger varying with the construction of the mill, the amount of dirt and other impurities in the stock—depending upon the grade of stock used—the means of removing some of the dust and other factors.

In thus presenting the facts it is not my intention to underestimate the importance of taking all practicable measures to eliminate cotton dust, so far as possible, in all departments, from the opening room to the cloth room. I do believe, however, that by calling to the attention of the public the avoidable dangers connected with the cotton processes with the same degree of emphasis that has for years been put upon the dust problem, which, from the nature of the industry, always will be to a certain extent unavoidable, much more good may be accomplished, for in this way all, or nearly all, of the avoidable objectionable conditions may be eliminated and the exact danger caused by the cotton dust in the several processes can then be more accurately judged.

In the absence of a law specifying the standard of sanitary conditions, State Inspectors of Health are instructed to use as standards the conditions which they find existing in those factories carrying on similar business in similar buildings within the Commonwealth where the health, safety and welfare of the working people are most completely protected.

Another example of an industry which is intrinsically dangerous to health is the pearl industry, in the manufacture of pearl buttons and ornaments. Here, unlike the cotton industry, the dust problem is practically the only one of importance, so far as the health of the employees is concerned. That is to say, the

essential factors favoring health are two: (1), a reasonably good room to work in, and (2), the efficient removal of pearl dust. Unlike the cotton industry, too, all but one of the processes are attended with serious danger, even with most approved methods of removing the pearl dust, because fine pearl dust, in quantities not appreciable to the naked eye, escape in the air near the employees who are constantly handling pieces of pearl shell. Much can be done, however, to safeguard the health of workers in this industry by installing and maintaining suitable dust-removing devices, as the following facts show. In two of seven pearl factories, or factories where pearl working is done as a part of the trade of jewelry making, the cutting machines were found to have no hoods or exhausts, owing, perhaps, to the fact that the process of cutting appears to give rise to the least amount of dust of any of the machines used in the dry processes in this industry. In the pearl working room of one of these factories, where the processes of cutting, sawing, grinding and doming pearl shells were conducted, there appeared to be but a slight amount of dust. On the other hand, in another factory all the processes in the pearl workroom were attended with the production of great amounts of pearl dust, in spite of dust appliances on all but the cutting machines. Again, in a pearl workroom in a factory where all the machines were equipped with appliances for protecting employees from dust, there appeared to be more dust than the appliances could take care of. On the other hand, in the pearl workrooms in another factory where every machine creating pearl dust was equipped with hoods and exhausts, including the process of wet sawing, there was no appreciable amount of pearl dust in the air of the room, and the conditions as to cleanliness were very good. A study of this small group of pearl factories brings out the following points which are of value:

1. With every machine except the cutting machine supplied with a dust-removing device, there may be but a slight amount of dust to which employees are exposed.

2. With every machine except the sawing and cutting machines supplied with a dust-removing device, all the processes may be attended with the production of great amounts of dust to which employees are exposed.

3. With every machine supplied with a dust-removing device there may be more dust to which employees are exposed than the appliances can take care of.

4. Every machine may be supplied with such a dust-removing device that no appreciable amount of pearl dust can be detected in the air of the room. In the first case, it may be a fact that the process of cutting pearl shell gives rise to the least amount of dust of any of the machines used in the dry processes in this trade. This is not sufficient reason, however, for failure to equip the cutting machine with a dust-removing appliance. The second and third instances illustrate how a factory may apparently be well supplied with apparatus for the removal of dust, but on careful examination the apparatus found quite ineffective and the employees not properly protected against dust. The fourth instance shows how the health of the working people is best protected, viz.: By equipping and maintaining every machine with hood and exhaust in such an efficient manner that no appreciable amount of dust can be detected in the air of the room, and by maintaining otherwise a high standard of cleanliness. The fact remains, however, that, with the most improved processes of manufacture, employees in the pearl industry are always subjected to a certain amount of dust which, being a non-metallic mineral dust, not only irritates the throat and trachea, causing one to cough and to clear the throat by expelling mucous with dust, but may, over a period of years, extend its action to the lungs and give rise to shortness of breath and other symptoms of dust-diseased lungs, or of tubercular complication. For this reason, I believe it none too radical a step to bring such pressure to bear upon the manufacturers of mother-of-pearl goods as will prevent the employment of either boys or girls under eighteen years of age.

At this point the speaker showed a series of lantern views of some of the best mill rooms in Massachusetts, where the conditions as to light, ventilation, gases, humidity, etc., are practically ideal. Views of processes in the pearl and other dusty industries were then shown with the object of laying emphasis on certain industries and processes which are of special hygienic importance either because of conditions inherent in the industry or because of those which should not be connected with the industry.

Six months later the Legislature of Massachusetts passed the following Act relative to the employment in dangerous trades of minors under the age of eighteen years:

Chapter five hundred and fourteen of the acts of the year nineteen hundred and nine is hereby amended by striking out section seventy-five and inserting in place thereof the following:—SECTION 75. The state board of health may from time to time upon the written application of any citizen of the commonwealth, or upon its own initiative, after such investigation as it considers necessary, determine whether or not any particular trade, process of manufacture or occupation, or any particular method of carrying on such trade, process of manufacture or occupation, is sufficiently injurious to the health of minors under eighteen years of age employed therein to justify their exclusion therefrom, and every decision so rendered shall be conclusive evidence of the facts involved therein, except so far as the same may later be revoked or modified by a subsequent decision of the board. Whoever, after being notified that the state board of health has determined that a particular trade, process of manufacture, occupation or method is injurious as above stated, employs therein a minor under eighteen years of age shall be punished by a fine of not more than two hundred dollars and not less than fifty dollars for each offence, unless prior to the time of such employment such determination shall have been revoked or modified so as not to include the employment complained of. (Approved April 16, 1910.)

THE VENTILATION OF INDUSTRIAL ESTABLISHMENTS.*

By Dr. C. T. GRAHAM ROGERS,
Medical Inspector of Factories, N. Y. State Labor Dep't.,
New York City.

I regret that my first words in appearing before this learned body should be an apology for the incompleteness of the paper about to be presented; but owing to shortness of time, and a large number of uncompleted reports of investigations into special industries, as well as the necessity of having my yearly report in the hands of the Commissioner by November 1st, it was an impossibility to look up important reference matter, and so present my part of the subject in a manner as satisfactory as I could desire.

While it has never been really expected of, or possibly even thought that a Department of Labor would have anything to do with the betterment of Public Health, nevertheless, it is a fact. That the Department of Labor of the State of New York has done much in this line cannot be doubted after reading the Annual Reports of the Department, and looking over the various sections of the Labor Law relating to the subject; besides, the Commissioner of Labor has sent a representative of the Department to participate in the meeting of this Association, whose object is the betterment of public health.

One of the subjects to which the Department has given considerable thought and attention during many years past, has been that of ventilation. In his Annual Report of the Factory Inspection Bureau for the year 1905, the Hon. John Williams, then head of the Bureau, and now Commissioner of Labor, recommended the securing of an apparatus for the testing of air in workrooms. The Hon. P. Tecumseh Sherman, former Commissioner of Labor, realizing the importance of properly handling the question as well as all sanitary matters, did much to secure the creating of the office of Medical Inspector of Factories.

*Read before the American Public Health Association at Richmond, Va., October, 1909.

Immediately upon appointment by the Hon. John Williams, and during the fiscal year 1907–1908, the time of the Medical Inspector was devoted entirely to questions of ventilation. Not being an expert in factory ventilation, or a ventilating engineer, his energies were bent toward securing CO_2 determinations, and the finding of a method or apparatus most suitable for accurate determination, that would be not only portable, but easily manipulated, and give rapid readings. The Pettersson & Palmquist apparatus was finally decided upon to start with, and has now been so modified as to be very portable.

Some 136 workrooms, and over 430 separate air tests were made during 6 months of the fiscal year of 1908, and a complete tabulation of the results may be found in the Eighth Annual Report of the Commissioner of Labor.

At present, the work of the Medical Inspector consists in making special investigations into individual industries, and so covering the entire broad field of Industrial Hygiene, but still giving considerable attention to the ventilating question.

Pure air is as essential to good health as is pure food and water, and is of economic value to the worker; hence, ventilation becomes an important subject in the study of Industrial Hygiene, but is unfortunately, a much neglected one. Great strides have been made in improving the ventilation of schools and dwellings, but comparatively little has been done regarding factories. It is true that considerable research work has been done regarding the questions of contamination by products of respiration and combustion, and some regarding dust and fumes, but it is too bad that so little real work has been done by the members of Medical Profession regarding the relation of proper ventilation in industries to morbidity statistics; especially as their income is derived mostly from the workers. Outside of recommending plenty of air, very few have undertaken to determine the purity of the air so recommended. The real research work has been left to those who are not physicians.

Despite many years of untiring energy of the New York State Labor Department, devoted toward securing means for, and maintaining of proper and sufficient ventilation in workrooms, and the unfortunate necessity of bringing prosecution for non-compliances, there still remains much to be accomplished. It

certainly has awakened not only the manufacturer to a recognition of the economic necessity for providing ventilation, and so in many cases securing compliance, but it has also awakened the ventilating engineer to a realization that systems planned and installed merely from blue prints and contracts, are not always effective and at times are mechanical impossibilities.

In the furtherance of the Department's endeavors to secure compliance with ventilation orders, the Medical Inspector has relied upon the older authorities declarations of CO_2 being a good standard in determining the impurity of air, and need for ventilation, but from results of a great many determinations for CO_2 made in workrooms of various industries, (which possibly cannot be exceeded for number or variety), it has become apparent that to do more intensive work, secure better results, and that all bodies directly or indirectly connected with betterment of health conditions of the Public, as well as the Public may more fully awaken to the dangers of impure air and poor ventilation, it is necessary to obtain a unanimous agreement of scientific opinions upon the following questions.

What constitutes impurities?

What shall be the standard for permissible impurity?

How shall we determine the impurities?

What remedy shall we apply?

In all places excepting industrial plants, and even in some of these, we have merely to deal with impurities resulting mostly from products of respiration and combustion, so a standard of impurity based upon CO_2 determinations may suffice, but in the industries we have dust, fumes, gases, vapors, and extremes of temperature and humidity, plus the products of respiration and combustion. Here a difficult problem confronts us; what shall we say are impurities of sufficient moment to insure ordering means for ventilation? While we may know of the deleterious, or even toxic quality of the dust, gas, fumes, or vapor present, the proprietor will not admit the atmosphere is impure, and in many instances the workers, having undoubtedly become habituated, show no outward evidences of its ill effects, and unfortunately we have little or no reliable morbidity statistics to aid us.

Then arises the question: What shall be the standard of permissible impurities?

Carbon dioxide in excess of a certain amount has always been accepted as a standard, but there has been quite some difference of opinion as to the permissible amount; nevertheless, where the question is merely one of contamination by products of respiration and combustion, it is undoubtedly satisfactory, but where we also have dust, gases, fumes, vapors, and extremes of temperature and humidity to deal with, what shall be our standard, or must we have a number of arbitrary standards for the various conditions in each industry? This is the problem confronting those dealing with ventilation of industrial plants. To those whose duty requires the bringing of prosecution proceedings for a refusal to ventilate, what scientific standard may be offered in defence of issuing the order?

During the months of June, July, and August of this year, determinations of CO_2 and temperature and humidity readings were secured in a large number of cellar bakeries, situated in the various parts of New York City. All tests were made after dark, and for comparison, outdoor readings of CO_2 temperature and humidity were obtained. The means for ventilation in the majority of places visited consisted of small windows over the oven, and a stairway to the street or rear yard. It is a general opinion that cellar air is far from pure, and it is very evident that where a baker's oven is present, there will certainly be some coal gas; this, with illuminating gas being used, and extremes of heat and humidity, would very naturally lead us to expect high readings of CO_2, the usual findings were 7–8–9, in but very few instances were any higher readings obtained. These were all volumetric, and represented parts in 10,000 vol. In an investigation of the pottery industry, the results of CO_2 determinations showed from 7 to 10 parts in 10,000 vol. Outside of the dust the air seemed as fresh to the senses as outdoors. Results of tests in a polishing and buffing room, where large quantities of dust came from rag buffers, and tripoli used on wheels showed only 7 to 8 parts CO_2 in 10,000 vol. But in the tailoring industry, tests made with windows open showed as high as 32 parts in 10,000 vol. in midst of workers, and at the open window, readings showed 21 parts. From this we may see that in but one instance is our CO_2 standard alone, a sufficient indicator of need for ordering means for ventilation to be installed.

Valuable data has been secured by the Department through tests for CO_2 having been made by the Medical Inspector in the following industries: Cigars, Clothing, Furs and Fur Goods, Hats and Caps, Kid Gloves, Laundries, Paper Boxes, Printing and Publishing, Calico Print Works, Pearl Buttons, Human Hair Goods, Shoes, Carpet Weaving, Tin Cans, Potteries, Bakeries, Jewelry, Buffing Brass and Copper. In addition to tests made in industries, tests were also made in the basements of Department stores by Deputy Mercantile Inspector Vogt of the Department.

The apparatus used in making the determinations was the Medical Inspector of Factories, modification of the Pettersson & Palmquist apparatus; all tests were made and readings were taken directly upon the spot. Each sample was 25 c. c., and readings were parts in 10,000.

Did we base our orders merely upon CO_2 determinations alone, unhealthful and dangerous places would be permitted to exist. Apparently then CO_2 is but a partial standard; should the standard then be one which would not only specify the proportion of CO_2, but the proportion of dust free from all irritating particles or fibres, certain bacteria, absence of irritating, noxious, or toxic gases, fumes, and vapors, and a certain degree of temperature and humidity?

Or, should we, in dealing with industrial plants, take the accepted analyses of pure country air as a standard, and decide that where anything in the form of dust, gases, fumes, or vapors, may be found in addition, it shall be considered an impurity, and ventilation ordered? This brings forth the question, what shall be a standard method for determining the impurities? It is true that we have many methods of analysis based upon certain principles, but in prosecution we should have an available standard that may be appreciated by the laity, otherwise our work is of no avail.

Analytical methods are slow, and require time, patience, and careful manipulation, especially where very accurate results are necessary; but where the question of health is involved, may we not set a limit of fineness, and have a standard method of easily and quickly determining the presence of impurities, not for

accurate scientific data, but for convincing the laity of the need for proper ventilation, and thus accomplishing much good.

Even while realizing what a difficult problem it is, I believe that a great amount of energy should be devoted toward securing some means of impressing the laity, and of being able in prosecution work, to definitely show the danger, without having to enter into scientific discussions which as a rule merely tend to confuse Court and Jury, and many times does much to lessen the standard of the professions in the eyes of the public.

What remedy shall we apply where the air is impure? Here it might be said we trespass upon the ground of the ventilating engineer. I rather think this is where prescriber and dispenser should work together. Shall we depend upon natural means alone, or must we install artificial means, and if artificial, what shall be the system installed? In industrial plants, natural means alone are not to be relied upon, as proven conclusively by results of tests, and with the so called window ventilators installed, conditions were found to be but very little improved, notwithstanding extravagant statements to the contrary. It is true that in certain small industries confined to small rooms in converted dwellings, where contamination is merely the products of respiration and combustion, and where it is almost an impossibility to install motor means for ventilation, window ventilators of the check valve type could be used, and aided by lighted gas jets placed above the heads of the workers, and thus a certain amount of circulation might be insured. In this case while it must be admitted that the gas is a source of impurity, it is also an aid in creating sufficient heat to assist in causing air circulation. This fact is borne out by the extensive experiments carried on by Rideal as to "Relative hygienic values of gas and electric lighting" (Journal of Royal Sanitary Society, March, 1908, Vol. XXIX, No. 2). It is most unfortunate that a living room only was used.

If a system is decided upon, which is best? Theoretically and from results obtained, the combined plenum and exhaust appears to be the best, but it is costly. Not being a ventilating engineer, it is beyond me to enter into a discussion of the various other systems, fans, etc., but this I do know, that the results of CO_2 readings made during the operation of various systems, has shown the superiority of the combined plenum and

exhaust. The mere introduction of a blower or exhaust fan is no guarantee of ventilation, for if the exits or intakes are not kept open, the fans may be running at a high speed yet very little air will be moved; again, they may be the means of introducing large quantities of dust, or of creating cold draughts, thus increasing instead of remedying bad conditions, or, arrangement of system may be such that air currents are so far above the heads of workers as to be useless. The result of an investigation of the effect of ventilating fans in restaurants, dwellings, laboratories and public places in Brussels, showed a larger amount of bacteria per cm. of air with the fan running than when still. This is especially true of the small electric cooling fan, for the results of tests made in 1908 by the Department, showed a much larger amount of CO_2 in the air current created by the fans, than in the other portions of the work room.

The cry in the past was for more light, now it is for more air; we need both, for sunlight is essential to pure air, and especially in factories, but both must be unadulterated to be of service; because they are the free gift of the Great Creator, they are refused, and even avoided; even by those who should spread the glad tidings of its benefits is it neglected, as for example: At the request of a lecturer in a large Dental College, CO_2 determinations were made in various parts of the lecture hall, during his lecture, time 4:30 P. M., 115 male students present, electric lights, windows closed. T. 62:. H. 59.

CO_2 at lecturer's table, 13 to 16 parts.

CO_2 at lower rows of amphitheatre seats, 16 parts.

CO_2 to upper rows of amphitheatre seats, 17 parts.

This is in my opinion a bad state of affairs. If the professions neglect to provide proper ventilation, what can we expect of the laity.

A most worthy aim then should be not only the securing of scientific data and creation of scientific standards, but the education of the laity to observe certain homily standards, so aiding in increasing the physiological resistance of the body to disease, making the nation stronger, not only physically, but mentally and morally.

[3120 Broadway.]

THE SEX PROBLEMS IN INDUSTRIAL HYGIENE.*

By MRS. FLORENCE KELLEY,
Secretary of the National Consumers' League, New York City.

We are profoundly unfortunate in America in having no basis of knowledge on which anyone can intelligently discuss the subject assigned to me. We have begun feebly to scratch the surface of this subject, but we have no basis on which anyone can present an intelligent paper. All that we can do is to indicate our lack of knowledge. For more than one hundred years working men have lost no opportunity to make public, in every way open to them, their conviction that the most important step that can be taken towards protecting the health of women and girls in industry is to shorten their working hours. It is more than a century since the working people of England first began their effort in the name of the public health to get a shorter day for women. In 1847, during the agitation in Parliament for the ten hours working day for women and children in England, Lord Macaulay was asked in the House of Lords: "How do we know that there will be any improvement in the health of the working people if this bill passes?" He said: "We have no body of knowledge, we have no body of facts, there is no experience from which we can prove it, but the human mind knows that it is bad for women and little children to spend more than ten hours a day in any indoor occupation." That was in 1847. The bill carried, and it was largely that speech of Lord Macauley's which carried it through the House of Lords. But in 1895, in the enlightened State of Illinois, the Supreme Court of that State held that it was contrary to the Constitution of the United States and to the Constitution of the State of Illinois, to grant to women in Illinois the same degree of protection from fatigue which had been granted to women and children in England in 1847. The court was unanimous. It spent 9,000 words in explaining why it was contrary to those Constitutions to protect the health of women in Illinois in that way. The Illinois statute of 1893 was annulled, and to this day women in Illinois have no

* Read before the American Public Health Association at Richmond, October, 1909.

protection against overwork.† It was good law in England since 1847 and good law in Germany since 1891. It was good law for several years following 1886 in New York, but in the great majority of our cities today it is perfectly lawful to require women to work in a factory, or laundry, or store from ten to twenty hours, or any number of hours that any rush order may require.

Two years ago a case involving the ten hours day for women was pending before the Supreme Court of the United States. A distinguished New England lawyer, Mr. Louis D. Brandeis, freely gave his services in the interests of the working women and in defense of the law. Mr. Brandeis told my young assistant to compile all the information that could be laid before the court under the heading of "common knowledge" on this subject. The common knowledge of the world with regard to fatigue had to be gathered together for the use of the Supreme Court of the United States. My assistant worked for three months. She had readers at work and twelve libraries co-operating. They piled up a great amount of common knowledge of the whole world with regard to fatigue in working women. When she was about to print, I said: "How are you getting along with the brief?" She said: "When it is done we ought to print as its title: "What every fool always knew; it is bad for people to get over-tired.'" However, a wise man said to us: "You will have to admit that, although every fool does know it, some of the wisest men have not yet acted upon it, for look at the decision of the Supreme Court of Illinois."

When I was asked to address this body I was filled with fear that it might seem that what I had to say was only what every fool has always known. I became convinced, however, that there are many medical men in the United States, wise men, who have not acted on this knowledge which we have delivered to the Supreme Court of the United States.

We had for some years a statute in New York providing that girls should not work in stores after ten o'clock at night; that they should have seats, and should be free to use the seats whenever such use did not interfere with the active per-

†Since the meeting was held, the Illinois Court has reversed itself and sustained the new ten hours law for women

formance of their duties. It was left to the Departments of Health of the cities to enforce that law, and it was never enforced. There was one particular Christmas when there was a little spurt of enforcement as to children under sixteen, but there was never any real enforcement as to girls between sixteen and twenty-one. The number of seats was never complete in the stores. When we reproached a Commissioner of Health he said: "We cannot. We have no time to look after details like that. We have to fight smallpox and tuberculosis. We cannot go and find out whether Jane Smith is over fourteen years or under, or whether Jennie Jones has a seat to sit on or not; we have more important things to do."

I had then a young neighbor who came to New York from the west of Ireland, a broad shouldered intelligent girl. Her father was killed in an accident. She went to work in the dress-making department of a store in New York City. She was a highly skilled fitter of sleeves into ladies silk waists. Very few girls could exchange work with her because few were as skillful. She was required just after Christmas to work six weeks from eight in the morning till six in the evening, and then to work three nights in the week until nine o'clock. She was given half an hour for supper. She had an unusually intelligent mother who kept hot cocoa for her when the girl came home late and weary. She was given a tempting luncheon to carry with her to eat cold at noon. But she was more tired each day and her appetite lagged. Maggie Sheehan was just as effectively killed by her employers and by the failure of the Commissioner of Health to enforce that ten hours law as if they had given her an overdose of strychnia. Perhaps you may say that young peasant girls who come from the west coast of Ireland are peculiarly subject to tuberculosis. So they are, and therefore, they ought to have extra consideration. You may say that Maggie lived perhaps in an infected tenement house. It is likely that she did. The great number of our tenement houses are breeding places of tuberculosis. But that is the reason why Maggie Sheehan ought to have had extra care. She is one of tens of thousands of girls who have been killed by overwork because our officials have thought they had more important

things to do in fighting more sensational forms of disease, instead of doing such humble things as enforcing shorter hours of work and protecting the resisting power of the young so that they can live with their germs. Everyone knows that we all live or die with our germs just in proportion to the amount of resisting power we have for them.

The common knowledge we gathered together was presented to the Supreme Court two years ago, and they decided that it was not only the right of the State of Illinois but the duty of every State to restrict the working hours of women. Before that decision was handed down we had only time to scrape together 162 pages of common knowledge. We have been at work at it ever since. We have now a mass of common knowledge on the subject and it is a disgraceful thing that only one page of it is furnished by America. We have no medical literature on the relation of sex to industry.

About twelve years ago the miners of Utah decided that they needed in the interest of their health a short working day. The Supreme Court of that state agreed with them, and held constitutional the statute establishing for the miners the eight hours working day. The case was appealed to the Supreme Court of the United States, which said that, whenever it could be shown to the satisfaction of the Court that the restriction of the working day of adult men was indispensable to the public health, it was within the power of the state to enact such a law. Since then fifteen States have shortened by statute the working day of all men and boys who work underground.

A few years later the bakers in New York City, who also work underground, because they work in cellars with rats and filth, decided that they needed a shorter working day. They were modest and only asked for a ten hours day. The case was appealed to the United States Supreme Court who said that it had not been shown to the satisfaction of the court that baking was an injurious occupation; if it were, the mothers of the country would have shown the evil effects of baking throughout our history, which they had not done. The judges were not acquainted with the underground bakeries of our great city. Unhappily the bakers' legal counsel had not been fore-

warned that it was necessary to lay before the Court the common knowledge on the subject, so the bakers lost their case.

Two years ago when Mr. Brandeis laid before the Court the common knowledge with regard to the relation of fatigue to the health of women, the judges did not inquire at all whether the work under discussion, which happened to be laundry work, was intrinsically dangerous, like work underground in the mines, or whether it was not intrinsically but only incidentally dangerous, like the work of a baker in a cellar, which is incidentally dangerous by reason of the preventable conditions under which it is done. The judges did not inquire whether it was intrinsically or non-intrinsically dangerous. They said that in view of the mass of 162 pages of common knowledge before them, ten hours work was enough for any woman to do in a laundry, factory or mechanical establishment.

Why do the Health Officers in all the cities of the United States not rise up as one man and tell the truth, which their deputies must know if they do not, that the great majority of the loaves of bread baked under the conditions under which baking is done in American cities are not fit to eat? The loaves are commonly exposed to the marauding of rats and cats, and all insects, and to sewage, to tuberculosis germs, and to the palms of the hands of bakers, many of them unfit to touch their own food, much less yours and mine. I was four years inspector of factories and shops, and I know whereof I speak. It is a grave sin of omission of the Health Officers of this country that any woman is in danger of buying bread such as all women are liable to buy today. I understand that Dr. Evans has closed many of the cellar bakeries in Chicago. I understand also that the cellar bakeries of Milwaukee are in process of being closed. So long as the women of the United States have to depend on having the law enforced for them, we are all of us in danger of feeding poison to the men of our families.

Sometime there will be sufficient common knowledge to induce the Supreme Court of the United States to reverse its decision and shorten the working day of the bakers, but in the meantime the shame remains that, in gathering together the great body of common knowledge as to the relation of fatigue to

disease in the case of the rapidly increasing millions of women who have to earn their own living in industry in this country, we got far more valuable information from Italy than from the whole of the United States. We have but one page of literature gathered in our own country. I hope you will fill out this vacuum before the next decision comes along.

THE RELATION OF LIFE INSURANCE TO PUBLIC HYGIENE.*

By Dr. LEE K. FRANKEL,
Metropolitan Life Insurance Co., New York City.

Probably in no other civilized country would it be necessary today to explain the relation of insurance to industrial and social hygiene. In countries like Germany, Austria, Switzerland and Holland, in fact, in practically every European country, the question of insurance has for decades been co-related with that of hygiene and the prevention of disease. In certain European countries, insurance is compulsory on certain elements of the population. Where, under such compulsion, sickness or old age insurance has been developed, and even where such development has been voluntary, it is found that the insurance of the workman presupposes not only his care while ill, but his protection against the ravages of disease.

In large cities, such as Berlin, Vienna, Leipzig, and Dresden, concerted and centralized efforts have been developed tending to the education of insured workmen along the lines of hygiene and preventive medicine. Not only is the insured workman entitled to treatment and medical care but every effort on the part of the centralized bodies is directed to educating the insured either through the distribution of pamphlets or through lectures so that he may know how to guard himself and to prevent sickness.

Very recently, insurance companies in the United States have taken up this question of the education of their policy-holders and have distributed pamphlets indicating how life may be prolonged. The entire question was brought to the notice of the insurance public during the past year in a very able paper by Professor Irving Fisher, in which he called attention to the opportunities open to insurance companies to educate their public, so as to reduce mortality and to prevent morbidity.

I must become personal in the remarks which I wish to make from now on and direct your attention to the work being done

* Read before the American Public Health Association at Richmond, October, 1909.

along preventive lines by the company which I represent, namely: The Metropolitan Life Insurance Company. Some months ago, this company applied to the Superintendent of Insurance of New York for permission to erect a sanatorium for the treatment of tuberculosis. Since then, it has distributed a pamphlet entitled: "A War Upon Consumption," to its Industrial policyholders. The company has in contemplation the distribution of other literature which shall guide the policyholders and enable them in a measure to prevent occurrence of other diseases. The company, as you are probably aware, writes largely so-called "Industrial" insurance. The policyholders under this form of insurance belong almost entirely to the industrial classes, that is the wage-earners, of the United States.

In developing this form of insurance, the insurance agent not only writes the policy but visits the policyholder weekly and collects the premiums. We believe that for this reason we have built up a rather unique piece of machinery which may be utilized for the improvement of our industrial policyholders. Since the agents visit the policyholders at stated intervals, we feel that they can be made use of as agencies in the fight against disease. Our agents distribute the pamphlets, which we are issuing and are being instructed to give assistance in other directions in helping policyholders learn the rudiments of hygiene and to become acquainted with the modern development along these lines.

Carrying out this thought, it is readily realized that an insurance company may be more than an organization which insures the lives of individuals. We believe that an insurance company which caters to the working classes has not done its duty merely in protecting its policyholders against death. Life insurance should help the policyholder during his life as well. It should enable him not only to protect his family when he dies, but by the instruction which the company may give, the policyholder may be taught to so protect himself that he will not succumb readily to purely preventable diseases.

The records of the company show, for example, that 18% of the death claims which we pay are due to tuberculosis. At age twenty-four, 48% of our death claims are due to tuberculosis.

This is the age at which a man ought to live and not to die. If we can help to stamp out this disease, we can give these men a longer lease on life. We do not believe that there is any charity in this; it is merely the combination of business with altruism. As a social program, the company is stepping in and taking the families of our policyholders by the hand and trying to prevent that waste of life which is occurring year after year and day after day.

Referring for a moment to the pamphlet entitled: "A War Upon Consumption," we have distributed over four million copies of these to our policyholders. It is an elementary treatise but we believe it meets the needs of the class of policyholders with whom we deal. We describe the causes, methods of cure and methods of prevention of tuberculosis. In addition we have printed a list of sanatoria, hospitals, dispensaries, etc., in the United States, in which treatment for tuberculosis may be obtained and these, as well, we are distributing among our policyholders.

As you can readily understand, an insurance company has certain limitations under the law and it is a question to what extent such a company may go in the care of its policyholders. As it is, a policyholder is not only a policyholder but a citizen as well, and as such he has the right to seek the provisions for safeguarding health which communities may prepare for their citizens. It is our desire to co-operate with all these agencies, particularly with the health officers and health boards so that our machinery may be availed of in the direction of preventing tuberculosis and other preventable diseases. At the present moment, we are co-operating with health officers in various cities. We wish to co-operate with the health officers of all cities and towns in the United States as our policyholders are to be found in practically all of them. The value of such co-operation is indicated by the results obtained last winter in the city of Chicago. Our agents in that city distributed "The Little Ballot" through which those interested in the sanatorium movement brought the question of the erection of a municipal sanatorium to the notice of the voters of Chicago and we feel that through such distribution we were instrumental in securing a large vote in favor of a sanatorium. We hope you will realize that our agents

are at the disposal of health officers anywhere for similar movements.

May I speak of another thing we are doing? At the present moment we are conducting an experiment in the cities of New York, Boston, Baltimore, Washington, Chicago, Cleveland and St. Louis by sending visiting nurses to all of our sick policyholders in these cities. We are of the impression that in time such service may show a reduction in our mortality. Even if it does not, we feel that the visiting nurse will be of inestimable benefit to the sick policyholder since most of them would be unable to obtain such service unless we send it. We are unable to say at the present moment, what the cost of such service will be or whether it will eventually become permanent.

In conclusion, I again wish to accentuate our desire to co-operate with the various health movements in the United States. The insurance companies are vitally interested in these campaigns. If they can reduce mortality among their policyholders, it means that the policyholders will eventually benefit by such a reduction. It will mean that the companies will give lower rates than is possible at present. Owing to the fact that we are an Industrial company, we have the special ability to place our agents who visit our policyholders weekly at the disposal of health officers. In the name of the company, which I represent, I take this opportunity of extending whatever co-operation may be in our power.

THE PHYSIOLOGICAL ASPECTS OF VENTILATION.*

By THEODORE HOUGH,
University of Virginia.

It is an old story, that of the man who was unable to go to sleep in a strange hotel because he could not open the window before retiring; finally, in sheer desperation, he threw his iron boot-jack against the glass and broke it; after which he fell into a profound slumber which was undisturbed until daylight awoke him and revealed the fact that he had only broken the mirror which formed the door of his wardrobe.

I cannot say that this incident ever happened, but I have no doubt that the story truly illustrates one phase of the physiology of ventilation, namely the large rule which the psychic factor plays in it. If one knows that the air is bad or believes that the room is close, physiological results often follow which would not otherwise occur.

My own very limited laboratory experience with the subject under discussion furnishes another striking illustration of the same thing. Some years ago I was interested in a research which involved shutting the subject of the experiment for an hour or more in an airtight box approximately 3 x 5 x 7 feet, thereby subjecting him to the effects of respired air. The percentage of CO_2 rose to 50 or more parts in 10,000. When the observer opened the door the odor of the air within was almost overpowering; and yet, provided the water vapor was absorbed and the temperature of the box kept down, the subject of the experiment had not only been unconscious of this odor but had actually suffered no discomfort. It can hardly be doubted that if he had been conscious of it, he would not only have been very uncomfortable but could not have done the mental work which, as it was, he performed easily in many of the experiments. The substances producing the odor had accumulated so gradually and been so evenly distributed throughout the closed space that there was no adequate stimulus to the sense of smell; yet

* Read before the American Public Health Association, at Richmond, October, 1909.

they were there and should have excited any toxic action of which they were capable.

But granting all this, we have, of course, no argument against the hygienic importance of ventilation. It is the province of hygiene to secure and maintain the highest possible working efficiency of the individual, and we cannot doubt that, whatever the explanation or the mode of action, the air of a crowded, unventilated room is unfavorable to the highest working efficiency. We have here to try to answer the question, why is this air harmful?

The history of the subject shows clearly that the problem is not so simple as is often supposed. No doubt you are all familiar with the fact that the first attempt at explanation—that there is a deficiency of oxygen or an excess of carbon-dioxide in the air breathed—failed with the proof that in neither of these respects does the air of very badly ventilated rooms depart sufficiently from the normal to cause any physiological disturbance.* The settlement of this question cleared the ground for the search for the true cause, which was very properly supposed, as a provisional hypothesis, to be some abnormal constituent of the atmosphere, other than carbon-dioxide. The odor of the air proves the presence of abnormal constituents and its disagreeable character certainly suggests, although it by no means proves, that they may be harmful. One of the earliest experiments bearing on the subject we owe to Brown-Sequard. Air was aspirated through a series of bottles in each of which was placed a mouse. Between the fourth and fifth bottles the air was passed through strong sulphuric acid. Brown-Sequard reports that the first mouse to die was that in the third bottle while the mouse in the fifth survived without ill effects. It was plausibly assumed that the acid had removed some poisonous material other than carbon dioxide. The repetition of this experiment in the hands of competent observers has at times

* It should, however, be remembered that this is not the same thing as saying that oxygen deficiency or carbon dioxide excess has nothing to do with the ill effects, for the important thing is not the tension of these gases in the room, but in the lungs from which they are absorbed into the blood. It is conceivable that the consciousness of unpleasant odors, or other causes, may lead to more shallow breathing, this diminishing the volume of air breathed into the alvioli of the lungs and so cause lowered tension of oxygen and increased tension of carbon dioxide in the lungs despite the approximately normal content of these gases in the air of the room. Haldane and Smith have given us a simple method of determining the composition of the air within the lungs and it is desirable that this question be put to the test of investigation.

given similar results to those of Brown-Sequard and at other times given divergent results. Possibly this is to be explained by the differences in the rate at which the air is aspirated through the bottles or by some other uncontrolled condition of the experiment. It can hardly be doubted that, under the given conditions, toxic substances are added to the air; and, since these are removed by sulphuric acid, it is possible that they are of basic nature.

The presence of toxic constituents in the air of a crowded room is also indicated by experiments in which the water vapor of the air is condensed by cold and the liquid thus obtained is administered to an animal in one way or another. While the methods of work are decidedly open to criticism, it would seem that in many of them distinctly toxic and even fatal results have followed. In other experiments large quantities of the air of the room have been passed through sulphuric acid, the acid subsequently neutralized, and the liquid thus obtained has proved to have toxic properties.

Assuming that the positive results from experiments of this kind should be given greater weight than negative results, we are still justified in concluding only that the air of the crowded room contains some poisonous material. We are not justified in assuming that it comes from the lungs, since there is obviously the possibility of contamination from the skin, clothing, decaying food particles in the mouth, or catarrhal exudates from the air passages, and the like. This has an obvious practical bearing on the older teaching, that while the carbon dioxide is not of itself poisonous, it indicates the quantity of poisonous material present. This cannot be true unless the poisonous material comes from the lungs; and there seems to be practical agreement that, when the respired air is received directly from the trachea of a normal animal, it is not only itself odorless, but there is no odor in the liquid obtained when the tracheal air is condensed by cold; nor do any toxic effects follow the administration of this condensed liquid to an animal.

As to what these toxic substances are we can only cite the experiments of Formanek, who detected in the air of a cage in which an animal was confined, ammonia or ammoniacal compounds. These were not found, however, when the cage was

kept scrupulously clean. The same observer reports that the administration of small doses of ammonium salts produces the same poisonous effects as the air of an uncleaned cage. We may conclude that if there actually is a poison in the air of a crowded room, it does not come from the lungs but from the skin, mouth, clothing, etc. It is also doubtful whether toxic material is regularly present. While this material may and probably does exert a toxic influence on those regularly living in poorly ventilated rooms, it does not seem to offer an adequate explanation of the symptoms which develop within half an hour after entrance into the room. At the utmost the unpleasant odor of some of them may influence the working power by unpleasantly affecting consciousness; but there is no proof that the material giving rise to this odor exerts any *rapid* toxic influence, or even interferes with working power, so long as the subject is unaware of its presence.

In studying the physiological aspects of ventilation, it is of practical importance to distinguish between what may be called the acute effects of exposure of an hour or so to vitiated air, and those effects which are produced by prolonged exposure to such air. While the line cannot be sharply drawn between them, still it would seem that the toxic material acting for long periods of time should produce a cumulative undermining of health quite different from the immediate acute interference with the running of the human mechanism which all have experienced after half an hour's stay in a crowded room. I wish to suggest that the toxic material, so far as it is a factor, does harm chiefly if not entirely when it acts over comparatively long periods, and that we must seek elsewhere the explanation of the acute effects. They are sufficiently familiar to all; the dull heavy feeling; at times headache; the difficulty of sustaining attention, or even of keeping awake while listening to an address. Restlessness also develops, and this is often the expression of actual discomfort.

The symptoms are strikingly similar to those experienced in the warm muggy days of summer time, and in two respects the atmospheric conditions in the two cases are the same; namely, the high temperature and the high degree of humidity. Every breath of expired air leaves the nostrils at almost the temperature of the body, and saturated with aqueous vapor. The

result is the most unfavorable of conditions for the maintenance of the constant temperature of the body, in the effort to maintain which resort is had to vascular and other adjustments, which, while successful in their immediate object, are unfavorable for other physiological activities. So important is this maintenance of the constant temperature that almost everything else, such as digestion, mental work, and the like is sacrificed to it.

A constant temperature means, of course, the maintenance of equality between the heat production and the heat output of the body. Heat production, when the body is not engaged in muscular activity, is, to all intents and purposes, constant above 68 or 70 degrees F. At these temperatures it does not vary with external climatic conditions, and is not influenced by ventilation. The method of heat output, on the other hand, does vary with atmospheric conditions, and may be profoundly influenced by ventilation. It is so important to have this point clearly understood that, even at the risk of becoming tedious, I shall take the time to review the essential features of the physiology of heat output.

Heat is lost from the body chiefly in two ways. The first we may conveniently term *heat transfer*, and it includes the loss by radiation, conduction and convection; the heat thus lost is transferred to other objects the temperature of which is thereby raised. The second is by the *evaporation* of water, and in the body chiefly by the evaporation of the water of perspiration. The loss by heat transfer varies with the difference of temperature between the body and surrounding objects. Hence, the rate of heat transfer decreases as the external temperature approaches that of the body, which latter would rise as the atmospheric temperature goes above 70°, were not perspiration then secreted. So long as this perspiration can evaporate readily, there is little difficulty in keeping output equal to production. When, however, owing to high humidity evaporation is lessened, blood is rushed in larger quantities to the skin *at the expense of the flow to other organs;* the temperature of the skin is raised and so heat transfer by radiation, conduction and convection is facilitated. The normal temperature of the body is approximately maintained; but it is at the expense of the working efficiency of other organs and especially that of the brain.

Between the circulation in the skin and that in the brain there is a very close correlation; one is generally, if not always, secured at the expense of the other. Thus sleep is accompanied by increased cutaneous circulation; waking is preceded by a sudden, marked cutaneous constriction. Mental work, especially that involving interest and attention, is accompanied by still further limitation of the flow of blood to the skin. Conversely, whenever the cutaneous vessels are made to dilate, as on the warm, muggy day, the quantity of blood flowing through the brain is lessened. In these facts we probably find the true explanation of the dull heavy feeling, the difficulty of attention, and the discomfort both of the muggy summer day and of the crowded ill-ventilated room. It is not impossible, too, that the unfavorable circulatory conditions in other organs as well as the disagreeable sensation of an overheated skin contribute to the interference with working power.

I would, therefore, conclude that the most important if not the sole cause of the acute effects of poor ventilation is the combination of high temperature and high humidity which then obtains. It is neither of these acting alone but *the two working together* which introduce into the system the unfavorable circulatory conditions we have described. It remains for us to consider in this connection a feature of the relation of high humidity to heat output, which has a very important bearing on the practical problem of ventilation.

Humidity influences the output of heat from the body in two very different ways: It increases the conductivity of the atmosphere for heat—a cooling influence; and it interferes with the evaporation of perspiration—a heating influence. What the net result will be depends on which of these influences of humidity is predominant. Below 70° the second, or heating, effect drops out, because so little perspiration is then secreted, and a high degree of moisture chills the skin, as shown by the familiar effect of an east wind in winter along our northern Atlantic coast. Above 70°, on the other hand, because conduction is slower, it becomes necessary to evaporate perspiration and at these temperatures humidity heats the skin. Between these lower and higher ranges of temperature, there is a neutral

region at which high humidity has comparatively little effect. This region is about 68° or 70°. We have only to appeal to our own experience to see that high humidity chills the body at 65°, while it is hardly noticeable (in the absence of muscular activity) at 70°. In other words, so long as the temperature of a crowded room is kept at 68° or 70°, it makes little difference whether the humidity is high or low, so long as the occupants of the room are sitting still.

It follows from this that one of the most important, indeed, we may almost say, an absolutely essential object of ventilation is that of maintaining the optimum room temperature of 68° to 70° F., and fortunately the temperature of a room, except in warm weather is more readily controlled than the humidity. If the air is too dry, it is a simple matter to raise its content of water vapor to the normal—and this should always be attended to. If, on the other hand, there is an excessive quantity of aqueous vapor in the room, there is no economical way of removing it, the least expensive probably being that of introducing very large quantities of dry air. If, however, the temperature be kept down to 68°, high humidity may be largely neglected. I may here quote the actual experience of a friend of mine who had to secure good ventilation in a crowded lecture hall. He found that so long as enough cold air was pumped into the room to maintain the atmospheric temperature of 68° or 70°, everyone in the room was satisfied with the ventilation, while complaints would come in as soon as the room temperature rose above 70°. The quantity of air supplied was the same in the two cases; presumably the quantity of "poisonous exhalations" from the bodies of those composing the audience was also the same; and yet two or three degrees of temperature made all the difference to these people between good and bad ventilation.

When the room temperature cannot be kept down to the proper point by the introduction of cool air, fairly vigorous air currents must be maintained over the bodies of the occupants of the room. It is a matter of common experience that artificial systems of ventilation very frequently fail in warm weather, and the physiology of this is quite clear, for under these conditions ventilation must facilitate heat loss by favoring convection and

evaporation. The "aerial blanket" of stagnant air must be removed; and the very virtue of not creating a draught when cold air is introduced becomes the fatal weakness of the ventilating system when we can introduce only air of a higher temperature than 70°. The practical problem is an engineering one; but the conditions to be satisfied are perfectly clear.

SUMMARY.

In this paper I have dealt only with the question of the deleterious conditions introduced into a room by the presence of human beings in it. It goes without saying that deleterious conditions may be introduced in other ways—from leaky gas fixtures, by the updraft from damp cellars, and so on. A large room which has been closed but not occupied may and generally does require the introduction of fresh air before it presents ideal climatic conditions for even a single occupant. Hence the ever present need of the renewal of fresh air from without.

Within the limitations of our subject, I have tried to draw the distinction between the immediate or acute effects of poor ventilation and the more or less probable remote effects upon those staying for any length of time in rooms where the air is not renewed as it should be. I have shown that attempts to trace the *acute* effects of poor ventilation to the presence of toxic substances given off from the bodies of the occupants of the room have thus far been unsuccessful, although it does seem that prolonged exposure to some of these substances, especially ammonia compounds, may be responsible for the results of regular and prolonged exposure to vitiated air.

Whatever may be the actual role played by these emanations from the body, two other factors—one physiological and the other psychological—are of prime importance. These are the increase of temperature and humidity in the room, and the disagreeable sensation from unpleasant odors or from an overheated skin. The combination of high temperature and high humidity acts by rendering the output of heat more difficult; and the effect on the part of the body to maintain its constant temperature under these conditions introduces vascular and other conditions unfavorable to the efficient circulation of blood

through the brain and other organs. The psychological condition of uncomfortable sensations may act purely as a psychological factor, but it may also, like so many feelings or emotions, react on physiological processes and so lower the standard of working power.

Finally, while the introduction of fresh air is of great importance, indeed is essential, we should remember that equally important is the maintenance of the ideal room temperature of 68° to 70°, since at this temperature the humidity factor is almost negligible.

Section of Municipal Health Officers

INCINERATION OF CITY WASTES WITH UTILIZATION.*

By Dr. P. M. HALL,
Commissioner of Health, Minneapolis, Minn.

The methods for the disposal of city waste have gone through the various stages of dumping, both upon land and sea, pig-feeding, reduction and incineration. With all of these various methods the primary object sought was the getting rid of the natural accumulations incident to life in cities. The question of whether the disposal was sanitary or not was not thought of or at least, was a secondary consideration. Later, the question of sanitary handling has been thoroughly gone into, from the proper construction of the receptacle, to the final disposal. The care of the can and its contents; the vehicle in which the waste material is carried, and every step of the operation has been gone into to the minutest detail. The question of SANITARY disposal may be said to have been finally reached—methods varying only in different cities depending upon the kind and construction of the machinery for final disposal.

Much might be said in the mere recital of the kind and character of the receptacle—how it should be kept to prevent it from getting foul, to protect it against the dangers of fly infection, and gradually, in a general way, educate the householder to habits of cleanliness. The most fascinating side of this great question at the present time, however, is that which concerns the recovery of valuable by-products, or some means of utilizing the various component parts of the city's waste, that the cost of final disposal may be reduced or be made profitable. The mere question of disposal may be considered as settled.

In our own city we have been working for the past two years with this question of utilization, and I have thought that a brief recital of our progress might be of some general interest.

* Read before the Section of Municipal Health Officers of the American Public Health Association, at Richmond, Va., October, 1909.

After experiencing two fires, when the plant came up for reconstruction the second time, we first took up the proposition of preparing to utilize the heat generated in the burning of garbage and rubbish, in the development of electric current and the production of steam for heating and power purposes. By way of explanation I might say that we have the two-barrel system of collection. One can serves as a receptacle for garbage and combustible rubbish, and the other for ashes and such rubbish as will not burn. The two cans thus take care of all the waste material of the average household. We have insisted that all garbage be thoroughly drained of moisture and wrapped in paper, to do away with fly infection. In this way, the garbage and rubbish are collected comparatively dry.

Our old plant was composed of two units or incinerators placed side by side, each connecting with a common stack. In the resetting of the plant, a water-tube boiler of 150 H. P. capacity was placed between the two incinerators, and the hot gases arising from the burning garbage and rubbish were allowed to pass through this boiler on their way to the stack. To get additional draft an induced draft fan was placed at the base of the stack, and later this was supplemented by a forced draft fan under the grates. The first noticeable result following this installation was the increased burning capacity of each incinerator. Where formerly the maximum capacity of each incinerator was 50 tons of mixed garbage and rubbish in 24 hours, we are now able to burn as high as 150 tons in one incinerator in 24 hours. Each of the incinerators is water-jacketed on five sides. This enables us to use the incinerators as feed-water heaters for the water-tube boiler. Thus it is possible to evaporate a large amount of water, as all water entering the water-tube boiler coming from the incinerators under a pressure of 45 pounds is above the boiling point when fed into the boiler. Our first test of one incinerator working in conjunction with the boiler gave us 429 engine H. P.

In January of 1908, we installed an electric generator and began lighting all the work-house buildings, the Superintendent's residence, two green-houses, and the tuberculosis hospital. This brought about a saving of $2400.00 for light in the eleven months of that year. This was done without adding a dollar of expense to the previous cost of disposal.

In the latter part of November of the same year we began to furnish the steam necessary for heating all of these buildings, for heating all the hot water which was necessary, the steam for cooking and laundry purposes, and for the operation of the steam sterilizer at the tuberculosis hospital. The plan adopted was the gravity system, steam being furnished at 40 pounds pressure. This service of steam, heat and power saved the city $1000.00 so that the combined service of lighting and heating together with the other uses to which the steam was put, saved the city $3400.00 in round numbers for the year.

The service of heat through the winter added a little to the cost of fuel at the Crematory Plant, owing to the fact that the supply of garbage fell short of running one incinerator at its maximum capacity, and also on account of the fact that on Sundays and holidays it was necessary to furnish the service. This service of heat and light has been carefully recorded by proper meters, and for this year will save the city between $7,000 and $8,000.00.

In the operation of the plant we have learned some things which may be of value to others studying the same problem. We found, first of all, that we could easily operate a much larger boiler, and that to properly take care of this heat to best advantage, the type of boiler selected should be such that will permit of easy cleaning, as with a strong draft a great deal of light material is carried over into the boiler tubes.

Another point learned is that sufficient by-passes should be constructed so that each of the incinerators and the boiler itself can be operated independently of each other, or all together as the minimum or maximum demands of the plant require. There should be some provision made for the storage of material used for furnishing the fuel. This has been easily met in our case by utilizing our steel garbage boxes for storage purposes. All of our garbage is collected in steel tanks, hauled to a central transfer station, transferred to flat cars by electric hoist, and thence to the Crematory. At the Crematory Plant these steel tanks are lifted from the cars by electric hoist and dumped directly into the incinerators through an overhead hopper. It has thus been easy to use these tanks for storage purposes, dumping them at such times as they were needed.

We are at the present time installing a new boiler of about three times the capacity of the old one, together with a larger fan, larger stack, etc. We expect through this plant to furnish light and heat to a new addition to the tuberculosis hospital, a new cell-block of the work-house, a new hospital for contagious diseases, and hospital for incurables, which are to be installed during the coming year. Over and above the needs of these buildings, we will have sufficient steam to develop electric current for lighting the streets of four of the wards of the city—about 500 arc lights in all.

With the completion of the full plan of utilization, we will be able to dispose of our garbage for nothing and save the city in heat and light between $30,000 and $40,000 per annum. There is no question but that with proper facilities for the utilization of the developed steam, an incineration plant can be made to pay its own way.

DISPOSAL OF CITY WASTES AND CONSIDERATION OF NUISANCES IN EDMONTON, ALBERTA, CANADA.*

By T. H. WHITELAW, B. A., M. B.,
Medical Health Officer, Edmonton, Alta.

The disposal and destruction of garbage in Edmonton presents some difficulties, which will not be met with in the older Provinces and which add greatly to the expense of the scavenging department of our City. The soil surrounding Edmonton is so rich and apparently so inexhaustible that manure has no commercial value. Hence the necessity arises of destroying almost the entire product of stables, public and private. Previous to August, 1908, all garbage, refuse, dead animals and manure, were deposited in the nuisance ground and afterwards burned in the open. This process was necessarily slow and the whole neighborhood continually reeked with the fumes and smoke resulting.

Night soil was deposited in pits,,which when full were covwith a large heap of manure, the reduction of which to ashes afterwards by burning, was supposed to effectually cover and render innocuous the contents thereof. Owing to the rapid growth of our city, this nuisance ground eventually became the center of an inhabited district and it became necessary to adopt some method of destruction which would not be an offence to the citizens in the neighborhood. Consequently in August, 1908, the Decarie Incinerator purchased by the city began operations on the site of this nuisance ground. This incinerator had a capacity of 50 tons per day and cost $41,857.66.

We have this year added an induced draft fan to the plant which will if necessary increase its capacity to 75 tons per day.

Though the plant was not primarily intended as a manure destructor, it has, on account of the impossibility of disposing of this product in any other way, been used for the disposal of this material, as well as for all kinds of garbage, refuse and dead animals. Of the material destroyed which is about 50 tons per day on the

* Read before the Section of Municipal Health Officers of the American Public Health Association, at Richmond, Va., October, 1909.

average, about 90% is manure, and it requires a staff of one engineer and five workmen to man it, two of these being engaged on a night shift. The wages of these men together with wood, coal, repairs, light and telephone comes to about $500.00 per month and thus the actual cost of destroying all material is about 42 cents per ton as an average.

If, however, the manure had a commercial value as a fertilizer, as would be the case in eastern cities, one workman together with the Engineer would be ample, and an Incinerator of this capacity would be sufficient for a city of at least 50,000 population, or about double the present population of Edmonton, and would destroy all ordinary household garbage, dead animals, and offal from slaughter houses in an efficient manner. While this incinerator at present does destroy a portion of our night soil from a few pit closets, which unfortunately cannot be dispensed with, our experience does not lead us to recommend this method of destroying such material in a city where a system of sewers is laid down. We are rapidly extending our sewerage system and endeavoring to keep pace with our rapidly growing city and it is our intention to deposit all night soil and liquid garbage in manholes suitably placed over our trunk sewers, as the most satisfactory way of dealing with this difficulty.

Our scavenging at present is let by contract each year, which includes all household garbage and refuse, ashes and night soil, but manure, trade refuse, offal from slaughter houses, and garbage from boarding houses are not removed at the public expense. It is our intention to have, if possible, the scavenging done by the city in future instead of letting the work to contractors. Under the proper supervision of the Health Department which would have absolute control, it appears to me much more efficient service would be given the citizens at little if any increase of cost.

All garbage and combustible waste is burned in the incinerator.

Tin cans and other non-combustible material are deposited at present in a ravine near the incinerator. This accumulation of tinware is becoming so vast that some method of turning this material to commercial use may well be considered in the near future.

Ashes are collected and used for filling up low places and for surface covering in the lanes of our city. When worked in with the heavy black soil they make a very excellent road surface. Some difficulty is found in enforcing the By-law which requires all householders to keep their ashes in cans reserved for ashes only. Tin cans and broken glass are often carelessly thrown in with the ashes.

Night soil from pit closets and sanitary pails is deposited in the man-hole over a trunk sewer. In winter time thawing out of the sanitary pails, by boiling water, becomes necessary before they can be emptied. The system of sanitary pails adopted by our city some years ago, does not commend itself to me. It is expensive in operation, unsightly, unsanitary and from the general tendency for closets to get into a chronic state of disrepair, free access to the contents of the pails is afforded flies during the summer months. The great majority of cases of typhoid developing in our city, which fortunately are comparatively few in number, are derived from the areas where privies are still in use. Where it is impossible to obtain water and sewer connection it appears to me that well constructed brick and cement pits would be preferable to our sanitary pails.

A peculiar situation exists in our city due to the large number of tents used as dwellings both winter and summer. The rapid increase in our population and the scarcity of houses, some years ago, with high rents prevailing caused a great many to adopt tent life. Owing to the dryness of our atmosphere in winter and the absence of winds, thaws, blizzards or rains, these occupants of tents have found that a fair degree of comfort can be obtained in a well constructed tent with a wooden floor. By banking up with snow or earth to the level of the floor and having a suitable stove, which the abundance of cheap fuel makes it possible to keep going continuously, a tenter is enabled to defy even the coldest extremes we have here, even better than those who live in badly constructed houses. Consequently, a great many of those who began to live in tents as a temporary expedient, have continued to use them from economical motives, and thus a condition eventually came about, which compelled us to take some action to exclude tents from the best residential areas supplied with water and sewer services. The residents of these areas

naturally object to tents being located on vacant lots adjoining, their occupants usually paying a nominal ground rent of $1.00 per month or being merely squatters paying nothing. No sewer or water service being possible in a tent, privies and garbage heaps on which slop water is thrown are the inevitable adjuncts to a tent used as a residence.

The tent By-law was amended therefore, making it compulsory for tenters to remove their canvas roofed dwellings to the outlying parts of the city where water and sewer mains had not yet been established. The majority of them have complied but a small minority have, with obstinate pertinacity, refused and owing to legal technicalities and quibbles which are raised by the lawyers whom these tenters employ to defend them, it has been found a very difficult matter to enforce the By-law. The Police Magistrate would not accept as conclusive evidence, the plans of the City Engineer showing water and sewer mains laid, but asked me to prove that water was flowing in the pipes and that the sewers were in use. This I succeeded in doing by bringing in as witnesses, the residents of neighboring houses to testify that they were using water and sewer services. The next difficulty was to prove that the dwelling was a tent and not a building, and in one instance the Magistrate decided that there was sufficient lumber about the structure though it was outwardly a tent, to justify him in calling it something not a tent, and in giving a verdict against us. The defendant in this case is a wealthy man and owns a large house from which he is drawing rental.

We expect shortly to have a new Health By-law put into force which will eliminate all the defects of our old fragmentary By-law and give us power to strictly enforce the regulations governing compulsory water and sewer services. A license fee of $2.00 per year is now imposed as a tent license and, as a result of more stringent regulations which we have lately attempted to enforce, a marked diminution in the number of tent dwellers has been brought about. We have now only about 250 tent dwellings in the city, while some two years ago it was estimated that at least five thousand citizens lived in tents.

THE SCHOOL NURSE AS AN AID TO MEDICAL INSPECTION OF SCHOOLS.*

By GUY L. KIEFER, M. D.,
Health Officer, Detroit, Mich.

The medical inspection of school children was begun in this country, in a systematic way, about seventeen years ago. Boston was the first city to establish such a system and it proved so advantageous that many others soon followed. The plan of the work has been similar in the various cities and the development of the system has, in nearly all instances, been almost identical. Usually the first thing undertaken has been a daily examination of the school children who have been absent for one or more days, for the purpose of ascertaining whether they were suffering from some contagious disease which had remained unrecognized. Whenever such pupils were discovered they were excluded from school and upon their return, re-examined, to make sure that they had recovered, from the given disease. The next step in the development of medical school inspection has invariably been the examination of children for physical defects and then, as the work was further enlarged upon and improved, visiting nurses have been added to aid the examining physician in his labors.

It would seem that, inasmuch as this has been the history of medical school inspection, wherever it has been undertaken, the reasons for these various steps in its evolution must be the same in each case. The experience of the various cities, I will assume then, has been similar to ours in Detroit, namely, about as follows: After a corps of physicians had been at work for a time long enough to allow me to analyze the results obtained, I found that a majority of the cases of the milder contagious diseases such as tonsillitis, mumps and chicken-pox and even of the severer infections as for example, diphtheria, scarlet fever and measles, were in children having the more common physical defects, such as

* Read before the Section of Municipal Health Officers of the American Public Health Association, at Richmond, Va., October, 1909.

adenoids, enlarged tonsils, etc. The natural conclusion was that a better method of prevention would be to remove the cause; in other words, to make an effort to remedy the physical defects. The next thing that became apparent in this work was that children who had been excluded for various of the contagious skin eruptions—scabies, impetigo, and ringworm, and even those excluded on account of pediculosis, would not return and consequently, on account of the neglect or carelessness of shiftless parents, were deprived of weeks and often months of schooling to which they were justly entitled.

It was also noticed that only a small percentage of the parents, to whom cards were sent calling attention to a physical defect in the child and recommending its correction or removal, paid any attention whatever to this kindly and timely advice and the work of examination and recommendation had been done in vain. The solution of the problem seemed to present itself in the employment of a trained nurse for the purpose of "following up" these various cases. The experiment was tried in Detroit several years ago when the Visiting Nurse Association of that city furnished the Board of Health with a nurse for this purpose. It is the duty of this nurse to visit the homes of children who have been excluded from school for contagious diseases to see that they have proper attention. When medical attention is required she prevails on parents to call in their family physician, or, in case they are too poor to pay for the services of a physician, she sees that the city physician is summoned. In minor contagious conditions, such as pediculosis and the like she shows the mother how to clean the child's head and, in many cases, she actually does the cleaning herself. When the child has been examined as to its physical condition and a card sent home recommending the correction of some physical defect, the nurse sees that, if possible, proper attention is given the child. It is cared for either by the family's physician or at a free dispensary, to which latter the nurse in many cases takes the child.

Besides all this, the nurse conducts what might be called a clinic, in each school at which she attends. At this clinic the nurse attends to such minor defects and ailments as may be corrected without sending the child to its home. The results obtained after a year's experiment were so satisfactory that the Board of Health asked for an appropriation sufficient for the

employment of four nurses. Two nurses were granted last year and an additional one this year so that now we have on our staff three school nurses. Each of these attends four schools daily and makes such other calls as her time will allow. During the past school year the two nurses made 1169 visits to the schools and 2723 visits to the homes of pupils. They gave personal attention and such treatment as was possible at the school clinic in 4651 different instances and personally took 158 children to free clinics for treatment. Besides this the nurses personally cleaned 46 heads in homes where the mothers were either too careless or too ignorant to administer this necessary treatment. Of the visits made to the homes of the pupils, 2262 were made because pupils had been excluded for contagious diseases and 461 because the correction of physical defects had been recommended. Of the 461 cases of physical defects, 289, or a little over 60 per cent were corrected. Of these, 152 suffered from defective eyesight and 76 received attention, the large majority of them being provided with glasses, 79 had diseases of the eye not due to defective vision but mostly conjunctivitis and all of these received treatment and were relieved. There were 28 cases of diseases of the ear, 16 of which received medical attention; 12 cases of defective hearing all of which were improved; 82 cases of adenoids, 50 of which were operated upon; 66 cases of enlarged tonsils, 25 of which were corrected; 36 cases of defective teeth, 27 of which were attended to; and six of phimosis, 4 of which were relieved by operations. It was found during the same year that of the cases of physical defects not followed up by nurses only about 20 per cent received attention.

Let us consider also the fact that the nurse during her visits to these homes is an instructor in hygiene. She teaches the mother and children something of personal cleanliness, care of the home, ventilation, etc., which they have never known and in this way disseminates knowledge of the prevention of diseases which is of inestimable benefit.

It is generally conceded by all practical sanitarians that a system of medical inspection of school children is an important factor in public health work and is of much service in limiting the spread of contagious diseases, but, in my judgment, the work of such medical inspection is only half done without the aid of the nurse.

REPORT OF COMMITTEE ON FOODS.*

No attempt has been made by your committee in its investigation to cover a wide range of territory, neither has there been an effort to include every subject which might be considered. Through the secretary, your committee was directed to report upon foods, and to give especial attention to the subjects of milk and water. In consequence of this injunction, it was deemed advisable to restrict the inquiry in an endeavor to gain a useful insight into the progress indicated along limited lines and in a fairly representative sense from the geographical standpoint.

PROTECTION OF FOOD STUFFS.

An energetic attempt is being made in many cities in this country to protect food stuffs, not commonly cooked before being eaten, from contact with dust and contamination by flies. The regulation in force in Washington, D. C., extends to dust and insects, and requires the wrapping or covering in a cleanly manner of all foods not commonly washed, peeled, shelled or cooked during sale or transportation. Foods and beverages in stores and restaurants are also required to be screened or protected by power-driven fans from flies and other insects. Boston's regulation, in addition to providing against corruption of foods by dust and insects, further prohibits contact with animals. The regulation of this last named city also aims to protect a wide variety of foods, such as meat, poultry, game, fish and sea food.

In Chicago, in addition to the efforts of the authorities to have food stuffs screened against flies, the public has been urged not to purchase foods which may have been contaminated through contact with flies.

An endeavor was also made to prevent this contamination of food stuffs in Indianapolis, Ind., Cleveland, Ohio, New Haven, Conn., and in some Massachusetts cities. In the first named city after a legal contest, the regulation was declared valid. The board of health of New Bedford, Mass., has a regulation of this nature under consideration. Washington, D. C., also has a pro-

*Read before the Municipal Health Officers' Section of the American Public Health Association, at Richmond, Va., October, 1909.

vision in its health rules, which is unique as far as the investigation of the committee goes, in that there is a prohibition against the exposure for sale between April 1 and October 1, inclusive, of any fresh meat or fresh fish, unless the same be kept at a temperature not exceeding 55° Fahrenheit.

This oversight concerning foods also extends in several cities to the condition of premises. In Washington, D. C., the authorities require the registration of managers of stores and restaurants where foods or beverages are manufactured, stored, or kept for sale. This is to facilitate systematic inspection, and the places regulated are arranged in routes, so that an inspector can conveniently examine the establishments within a given locality. A score card is used in connection with this work, and the finding of objectionable conditions is followed by proper action. The health department of Indianapolis, Ind., also uses a score card in this control of establishments serving the public with food stuffs.

Winnipeg, Man,. is another city in which a vigorous attempt is being made to protect all food supplies by requirements of great cleanliness during the various stages of manufacture, storage, and sale.

Boston insists on cleanliness in all establishments and appurtenances where food supplied the public is handled, and this provision extends to covers and screens on peddlers' carts, and the latter must be provided with a suitable receptacle for food wastes.

Salem, Mass., endeavors to ensure cleanliness of utensils, receptacles, and wagons used in the sale of ice cream.

Your committee believes these regulations, which aim to prevent contamination of foods by dust and other means, timely, and worthy of serious consideration where such ordinances have not yet been adopted. Especial emphasis should be paid to the better protection of foods like bread, cake, crackers, etc., from dust and dirt and contact with the hands and clothing of human beings.

WATER SUPPLIES.

The influence of the water supply upon health may be best learned by the experience of cities that have provided for the filtered or protected water supply during the last decade, and the

influence that the protection of the water has had upon the occurrence of deaths from typhoid. It was typhoid fever that induced the voting of money for the improvement of water supplies. The experience of several cities in New York State since 1900 is of interest. Niagara Falls, with a typhoid mortality rate of 114 to 184 per 100,000, with a gradual reduction of the rate to 87 after having partly filtered water, is now preparing to spend $350,000 to filter all of its water. Albany, with a former rate running to 87, is now maintaining a rate of minus 20, and sometimes as low as 10; the water has been filtered since 1897. Elmira, with a former rate of 33 to 80, having filtered water, now has a rate as low as 15. Binghamton has a reduced typhoid rate since she began to filter water, having in one year since beginning filtration attained a rate as low as 9. The most notable example in the above state is that of the City of New York, which is now spending $160,000,000.00 on the development and protection of a new supply of water. Practically all of the cities in New York State now have water that is properly filtered, or surface water entering large impounding reservoirs or upland streams with small reservoirs. The trend of engineering and public thought in this last named state is directed towards the adequate protection of supplies, and that not by extending intakes into lakes nor by inadequate sand filtration, but by that kind of protection that really protects, and that is by the best mechanical filtration possible.

Other large undertakings, which aim at the improvement of local water supplies, are those at Pittsburg, Pa., Milwaukee, Wisconsin, and of the Lake Michigan Water Commission. The members of this commission represent the cities of Chicago, Ill., Milwaukee, Wis., Grand Rapids, Mich., Hammond, Whiting, and East Chicago, Ind., and the States of Illinois, Wisconsin, and Indiana. The important and far-reaching inquiry in which this Commission is engaged will ultimately result in lessening the pollution of Lake Michigan, the water of which is used for domestic purposes by many cities and towns bordering upon the lake.

Milwaukee, Wis., is planning a new system of sewage disposal to obviate the necessity of discharging into the lake, and thereby overcome the present pollution of the city's water supply.

The boards of health of many municipalities have oversight of their water supplies through frequent chemical and bacteriologic examination, and are earnestly intent upon the problem of betterment of conditions. At Baltimore, Md., there was an attempt to install a filtration plant for improvement of the city water, which failed by reason of local county interests. Such an outcome is to be deplored. The question of the city well is one of great seriousness, and a determined attempt is being made in many localities to stamp out those wells which show evidence of pollution. At Washington, D. C., a few shallow wells are found, and these are being replaced as rapidly as possible by driven wells. Fifty-seven well and spring waters were examined at Cleveland, Ohio, in 1908; of this number 19 were condemned. Sixty-five per cent of the population at Indianapolis, Ind., use the municipal supply, the balance depending upon driven wells. Many of these are polluted, and are being closed as rapidly as practicable under the law. In Richmond, Va., the board of health is making a determined effort to close wells showing pollution. There are 5,000 wells in Milwaukee, Wis., 91% of which are contaminated. These are being filled and abolished by orders of the Health Department.

Some cities are endeavoring to regulate the sale of mineral waters. Two Massachusetts cities, Springfield and Lawrence, license dealers engaged in this traffic, and the Board of Health of the last named city prohibits the use of spring water containers for any other purpose. These bottled waters are subjected to frequent examination in many cities, and the recent experience at Washington, D. C., and Buffalo, N. Y., where an alleged spring water was found to contain B. coli, emphasizes the need of investigation. The above matters resulted in legal action, and in Washington a well was found to have been the source of the water in question.

Your committee believes that the pollution of large water supplies cannot be effectually checked by municipalities, and that the proper solution of this important question involves state control. Massachusetts is an example in point, the State Board of Health having complete charge of this subject. In that state water-borne typhoid has practically disappeared, and water supplies are adequately protected, and many cities have sewage

purification plants. The experience of Massachusetts is being duplicated in Vermont and in other states where, with protective legislation and ample funds, the control of this subject has been vested in state boards of health.

MILK.

There can be no doubt that the warfare against unclean milk is being followed by improved conditions, also a more intelligent understanding of the subject by laymen. But much remains to be done in the way of education of both producer and consumer. With this latter text in mind, the Health Department of Richmond, Va., has accomplished much in enlightening the public by issuing bulletins and circulars of information. This last named department has made successful use of the score card to the improvement of the nearby local supply. Score cards have been adopted in many other cities, and Indianapolis, Ind., Winnipeg, Man., and Chicago, Ill., report good results therefrom. The authorities in several cities destroy milk which fails to comply with certain requirements. Thus the Health Department at Baltimore spill milk, on arrival from the country, which has a specific gravity below 1.029 and a fat content of less than 3½%. In New York City and Cleveland, Ohio, a similar course is adopted with milk which has a high temperature. The water supplies of dairy farms forms a portion of this milk problem, which is destined to receive more attention in the future. The authorities at Winnipeg, Man., recently examined water from 85 dairies, and of this number 8 warranted condemnation. At Washington, D. C., water from wells on dairy farms is collected and examined chemically, and where possible bacteriologically. If found polluted, a new supply must be provided, otherwise there will be a revocation of the permit to send milk to the city, and if the farm is within the city limit, such neglect may result in prosecution.

The worst milk, from every standpoint, to be found in large cities, is usually that retailed at shops. The age of this store product combined with many and oftentimes careless handlings and unclean utensils, are the chief detriments to its quality. Despite this fact the bulk of the milk used by poor people is

supplied by shops. The problem of improving the quality of this shop milk at a minimum cost has caused the adoption of regulations in several cities requiring stores to sell bottled milk, the placing in containers to be done by milkmen. This method is in vogue in Chicago, Ill., Indianapolis, Ind., Springfield, Mass., Portland, Me., Cincinnati, Ohio, and the Board of Health of Boston, Mass., has recently decided in favor of bottled milk for stores. Approval of this plan, based on actual results, has been received from a majority of the above named cities.

A year of progress in the suppression of the tuberculous cow can be noted. At Winnipeg, Man., a beginning has been made in applying the tuberculin test to dairy herds, and this feature is made a prominent part of the work of dairy inspection in Washington, D. C., and the health authorities of Montclair, N. J., Chicago, New Orleans, and nine cities in Wisconsin, including Milwaukee, have adopted regulations aimed at these diseased animals. This latter city has been involved in a controversy, in which the legality of the law was an issue. Final adjudication of this point is still pending, but a preliminary victory has recently been won by the Health Department. Several states, particularly Wisconsin, have been engaged in conducting vigorous campaigns, but these efforts, to yield the best results, involve the education of the farmer, i. e., it must be plainly indicated to him that it is to his advantage financially to keep his herd free from tuberculous cows. In this manner the co-operation of dairymen may be secured.

In the oversight of milk supplies your committee is also of the opinion that control of the highest efficiency necessitates state intervention. It is impossible for all cities to inspect every milk farm. Milk produced under objectionable conditions is often handled at unclean creameries, and then after heating, finds its way as cream or milk to the city consumer. Such cream or milk, if excluded by the stringent regulations of one city, working independently, is likely to be immediately shipped to another city, or to some creamery, where it is made into butter or cheese. The best results cannot be attained by cities working independently; to obtain a satisfactory improvement necessitates state co-operation. It must also be borne in mind that too stringent regula-

tions on the part of large cities, in view of the present attitude of a vast majority of the purchasing public, would ultimately mean a milk famine.

Your committee further suggests that an attempt to unify the systems of inspection, as well as to provide a suitable method for the exchange of information, is worthy of consideration.

James O. Jordan, Chairman.
William De Lano.
George W. Goler.

THE CONTROL OF A LARGE MILK SUPPLY *

By W. A. EVANS, M. S. M. D., LL. D.,
Commissioner of Health, Chicago, Ill.

A city's infant mortality is said to be an index of its civilization. This is only approximately true. Several elements serve to disturb the accuracy of the maxim. Cities with a large Slavic population have a high infant mortality. A heavy Italian population increases the rate. A large Jewish population lowers it. So does a large native population. The temperature and humidity are modifying factors. The size of the place is of very great importance as is the age of the milk when it is sold. This is largely determined by whether the cow is in town or the milk is hauled in by wagon or by train. Milk supplies which are train hauled demand a standard of requirements far in excess of those required for town cow's milk or wagon hauled milk. Bad milk may do harm in one of several ways:

FIRST—By the development of alkaloidal substances, such as tyrotoxican—of minor importance.

SECOND—By milk intoxications from overfeeding of milk—of great importance.

THIRD—Through milk-borne bacteria and mild changes in the milk which transport them—of greatest importance.

The third head can be subdivided into groups ranking in the order named:

(1) Diarrhoea in infants. (2) Typhoid. (3) Tuberculosis. (4) Scarlet fever. (5) Diphtheria. (6) Diseases due to other microbic life.

The Chicago milk supply consists of 30,060 8-gallon cans a day. This is produced on 12,000 farms and by 120,000 cows. 2,000 of these cows are in the city limits; of the remainder, 90% are within 50 miles of the city. Practically all of the milk is shipped in on the train (all but 1,000 cans). The great bulk of it is produced in Illinois; much of it in Wisconsin; considerable

* Read before the Section on Municipal Health Officers of the American Public Health Association, at Richmond, Va., October, 1909.

in Indiana, a little in Michigan and a very little in Iowa. We have not the simple proposition of a wagon-haul milk for a town of a hundred thousand inhabitants. We have 2¼ million people with many Slavic babies removed two days and many miles from the source of their milk supply. Of course, they should have fresh certified milk. Of course, they are not going to get it.

The methods for the control of milk are those usually in force in the large American cities. We have the usual corps of farm, platform and town inspectors. We score farms and dairies on the government score cards. Our laboratory examines the milk chemically and bacteriologically. Milk that is improperly produced we decline to allow to be sold in our market. The farmer can produce as he pleases or sell to any one else whom he pleases but not to us. The records are all public. The dealer can get the record of the farmer he is thinking of buying from; the farmer can get the record of the dealer to whom he is thinking of selling. We have a Milk Commission which certifies three farms. This milk runs less than 10,000 bacteria per C. C. It sells at 15 cents per quart. It sells satisfactorily among people of the better class. These babies do not need much or any help from the health department.

In spite of our inspection system our poor people get milk which has a high bacterial count. It is not iced. It is dirty. The babies which need clean milk most get it the least. We are confronted by a condition, not a theory—the high browed Academician who sits in his library and says give the babies of the poor certified milk is like Marie Antionette who said: "If the poor cannot get bread they should eat cake." The idea that a large American city with a train-hauled milk can get a milk supply with a low bacterial count at a low price is an idle dream. It is not subscribed to by the men who are in touch with the situation. Such a control would require one inspector to say every 50 farms—say a corps of 200 inspectors in and out of town for Chicago. American inspections are educational and persuasive. They are no where compelling or militant. They can not deliver a milk which will average safe for baby use.

Recognizing the very great difficulty in controlling cleanliness, insanitary conditions and communicable diseases in farms and farm households removed many miles from the city; recognizing

the wide spread distribution of tuberculosis among cows and men, and the wide spread distribution of typhoid among farmers and farms, the Chicago City Council in July 1908, passed an ordinance which became effective January 1, 1909. This ordinance provided that all cows supplying milk to Chicago must be free from tuberculosis by January 1st, 1914, that the test of tuberculosis for the purpose of this ordinance shall be a reaction to the tuberculin test; that during this interval all milk not from cows proven to be free from tuberculosis shall be pasteurized according to the rules and regulations of the Health Department.

The principles involved in these ordinances are as follows: The average profitable milk cow does not remain profitable for five years. A farmer having his cows tested and finding some tubercular can segregate the tubercular cows, keep his hogs away from them, send the milk to a pasteurizer and keep the tubercular cows until they are no longer profitable when they can be sent to inspected slaughtering establishments and sold for beef. By allowing the farmer five years to get rid of his tubercular stock you save him money loss; in fact, you make money for him, and you therefore expect his co-operation.

But, you ask, is it safe for the people? Will pasteurizing kill the harmful germs? The ordinances provide that the pasteurizing shall kill 99% of all the bacteria and all of those capable of producing disease. I now propose to tell you of how we have succeeded with these ordinances.

Of Chicago's 30,060 8-gallon cans of milk, 18,000 are pasteurized, 7,000 are from tuberculin tested cows, and 5,000 cans are not complying with the ordinance. The 7,000 cans of tuberculin tested milk comes from 30,000 tuberculosis-free cows. Nearly all of our milk supply from Indiana comes from cows which have been tuberculin tested; about one-third of that from Wisconsin is from tested cows; but little of that in Illinois is from tested cows.

The tuberculin testing has been a source of much fraud. Veterinarians have faked reports and farmers have immunized their cows preparatory to the test. In Indiana the work has been done by the State and it is averaged very satisfactory. In Wisconsin and Illinois it is promiscuously done and much incompetency and much fraud has been shown and some has

been proven. Tuberculin testing can never be satisfactorily controlled in a market such as ours except through state or national control of the testing and the testers.

The pasteurizing is done by 43 plants in town and 100 in the country. Some of the plants have done excellent work. Some are faking and some are incompetently run. Most of the faking is done by creameries and other butter plants. The holding pasteurizers are almost uniformly good; the flash pasteurizers are sometimes good and sometimes not. A flash pasteurizer which heats to 168 to 180 and which does not harm the cream or give a cooked taste will do satisfactory work 75% of the time. A pasteurizer which affects the cream line at 160° to 168° will not do effective work because the operator will not run it at a high enough temperature. Our best results have come from 140° to 145° for 20 minutes. But expensive holding devices, while giving excellent results, hardly seem necessary.

Milk run through a cheap pasteurizer at 150° and then run into ordinary cans will be 146° or over in 20 minutes. If, then, it is rapidly chilled, the bacteria are killed, the cream line is good, and there is no cooked taste. An ordinary holding vat of sanitary construction and heated before the milk is run in will serve the same purpose.

Pasteurizers can be controlled by bacteriologic examinations of the product at the plant and on the street; periodic inspection of the plant; automatic registering dials and heat cut-offs; regulation of the size of the tubes to and from the pasteurizers. Pasteurized milk may become infected subsequent to pasteurization, but the likelihood of such happening is less than the likelihood of infection on the farm. In our judgment the control of pasteurization will be the easiest control in connection with any part of milk production or marketing. Conclusions drawn from uncontrolled pasteurizations are not applicable to controlled pasteurization any more. I cite you some figures on milk taken at the machine:

Raw	Pasteurized	Bottle	Cooler
3,450,000	33,000		
4,400,000	less than 2,000		
30,700,000	less than 2,000	550,000	
3,900,000	20,000	65,000	
3,760,000	20,000		
3,390,000	20,000	80,000	
6,700,000	94,000	150,000	
9,300,000			178,000
18,250,000		28,000	30,000
25,700,000	150,000		
16,400,000	less than 2,000		
4,350,000	53,000		
6,400,000	28,000		

Since January 1st we have taken 5,661 samples of milk and ice cream for bacteriologic examination. About 200 of these have been injected into guinea pigs and the remainder have been examined or are being examined or have been lost.

Since July 1st we have taken 2,301. The great majority of these have been taken from stores, depots and wagons. A minority have been from hospitals, homes and other consumers. Many have been taken at the pasteurizing machine. Fifty were ice creams.

The following is an analysis of 764 samples taken since the latter part of July: Pasteurized, 230; raw 534. Average number of bacteria in the raw milks to the c. c., 7,348,828; average number of bacteria in the pasteurized milks per c. c., 941,445.

	Pasteurized	Raw
Under 1,000	2	0
1,000 to 10,000	7	0
10,000 to 100,000	86	12
100,000 to 500,000	68	50
500,000 to 1,000,000	26	39
1 million to 5 million	29	217
5 million to 10 million	4	103
10 million to 20 million	7	79
20 million and over	1	34

Using one million as the dividing point and saying that milk containing over one million germs to the c. c. should not be fed to babies and that milk having under one million can be so fed, we get: Pasteurized, 189 samples under one million; 41 over one million; raw milks, 101 under one million and 433 over.

In ice creams the maximum count was 125 million; the average was over 20 million; 8 had 30 million and over.

The minimum ice cream was 10,000; several were under 100,000 showing that it is possible to make good ice cream.

Not infrequently a milk which was good at the pasteurizer was spoiled by a dirty bottle, a dirty cap or dirty fingers in capping.

The maximum number of bacteria found in a supposedly sterile bottle was 24,000. A count of 800 was not unusual.

We have examined into the spoiling of milk, pasteurized and raw, stopped and open, chilled and at room temperature. The results of these studies are embodied in a paper which has been prepared by Dr. Tonney, Chief of the Chicago City Laboratory. We are of the following opinion:

First—When milk is a few hours old there comes a time when the bacterial counts do not increase, but slightly decrease. This lasts about two hours.

Second—Pasteurized milk develops as high a degree of acidity as raw milk in about half the instances, but it requires about two or three days longer to develop it (according to the temperature of the experiment and whether it is stopped or unstopped).

Third—After the bacterial count has reached 300 millions to 500 millions there is a decrease in bacterial counts. This does not come at counts below these figures, nor in acidities less than about 40 to 50.

All in all, we are sure that it is easier to control pasteurization than it is to control tuberculin testing, and certainly than to control 12,000 farms.

With us, these ordinances are not only getting us better milk but they are helping us to get the farms cleaned up. Sanitation, a bogy, a fad to the farmer, becomes something real when he sees an expensive plant for purifying milk. Its effect is just the same as the location of a large up-to-date milk plant in a country neighborhood. Every farm in reach of such a plant gets cleaner year by year.

We are sure that in optional tuberculin testing or pasteurization properly controlled we have found the proper solution of this vexed milk question, a solution which in time will be found acceptable alike to farmer, dealer, consumer and health official.

Section on Vital Statistics

THE RELATION OF PUBLIC WATER SUPPLIES TO GENERAL AND SPECIFIC MORTALITIES IN CITIES.*

By Dr. ARTHUR LEDERER.
Sewage Testing Station of the Sanitary District, Chicago, Ill.

It is not easy at the present state of our knowledge to improve by additional figures what has been proven during the last few years. It may be that in the near future when our death certificates become more reliable, and scientific investigations more successful, we will be able to tell to what extent the water supply is liable in the propagation of specific mortalities, excepting typhoid fever. Since we know in a general way that intestinal disorders are caused by polluted water, the introduction of a pure water supply must necessarily be followed by a reduction in the general mortality. To what extent this holds true must remain in many cases a matter of speculation, because there are so many other causes to consider besides water supply which aid in the spread of diarrheal diseases; consequently, I must confine myself mainly to a discussion of the relation of typhoid fever mortalities to water supplies, this being the only disease where thoroughly reliable statistics can be had.

In spite of the fact that the water supply is the foremost typhoid fever bacillus carrier, it is very often extremely difficult to get evidence of the pollution of the water, especially in smaller towns which have a surface water supply and no constant supervision. A subsequent examination of the water after an epidemic has set in is in a good many cases worthless. Very often we have to draw a conclusion, by excluding all other factors which may have been responsible.

Rather recent experiments have also shown that stagnant water is much more unfavorable to the existence of typhoid fever

* Read before the Joint Session of the Section on Vital Statistics and Section of Municipal Health Officers of the American Public Health Association, at Richmond, Va., October, 1909.

bacillus than is flowing water. The results of Jordan, Zeit and recently Houston from the Metropolitan Water Board of London, have demonstrated that through storage most typhoid fever bacilli will perish, but there is still a "resistant minority" which makes storage not an absolutely safe procedure. Sedimentation is the main factor in the elimination of the bacilli in rivers, as well as reservoirs.

A good many investigations have been carried on here and in foreign countries, showing the extent to which water supplies take a part in the epidemiology of typhoid fever.

A very complete statistical investigation on the cause of 638 typhoid fever epidemics and of twelve single cases for the years 1870 to 1899, has been carried on by Schueder in Germany. In his article published in 1901 (Zeitschrift für Hygiene, Vol. 38), he states that 77.4 of the epidemics could be traced to an infected water supply, 70.8% of which directly. It is equally important to learn the percentage of distribution of epidemics among the different supplies. James H. Fuertes, in his book, "Water and Public Health," classifies the various supplies according to their safety as follows:

1st. Mountain springs, flowing waters and pure ground-waters, with a typhoid fever mortality of 5 to 25 per 100,000 population.

2nd. Impounded waters, large normal rivers, great inland lakes, upland streams and small lakes, with limited water sheds which are more or less inhabited; the death rate will vary here from 15 to 55 per 100,000 population.

3d. Polluted waters (including rivers, public and private wells) showing a typhoid fever mortality ranging between 40 to 100 per 100,000 population.

It can be easily understood that there are many factors which, under otherwise like conditions, may cause considerable diversity of these figures.

In looking over the statistics of 248 registration cities for the period 1900 to 1907, I find that 51 have had a typhoid fever death rate exceeding 100 per 100,000 of population at one time or the other for the eight year period up to 1907.

Recently, the "Engineering News" in an editorial (61 p. 680) has given statistics for 48 New York cities, classifying them

according to the source of water supply and stating the range of a typhoid fever death rate for the nine year period, 1899 to 1907, inclusive. Eight cities using unfiltered river water have shown a variation of 23 to 133 deaths per 100,000 of population; unfiltered well water, five cities show a variation of 16 to 40; filtered river waters, seven cities show a variation of 22 to 72; well or spring water, 7 cities 20 to 52 deaths; streams and reservoirs, 14 cities, 15 to 49 deaths. The conclusion arrived at in the article is that the low death rate with unfiltered streams and reservoirs may be due to the duration of storage, a factor of greatest importance. Attention is also called to the marked effect upon the rate of small errors in vital statistics, which also is my personal experience; further to the varying efficiency of local boards of health and to the fact that other sources besides the water supply must be taken into consideration. It is easy to see why a deep ground water should furnish the best water supply. The natural filtration to which the ground water is subjected necessitates its purification to a degree that it reaches the surface nearly free from bacteria.

There has been a greater mortality from typhoid fever in the rural districts of the registration area than in the cities for the eight year period, 1900 to 1907. The cities showing a typhoid fever mortality of 24.3 per 100,000 of population, the rural districts one of 25.6. The shallow well, often within a short distance of an open privy vault, is surely one of the factors responsible. A good many sanitarians are not inclined at the present day to consider it the main factor.

As the density of our population increases, we are sometimes forced to abandon supplies which have been formerly considered safe, until today filtration is considered the only safeguard from infection with waterborn diseases. The vast majority of municipalities at the present is still using unfiltered surface and ground water, but the history of foreign water supply is sufficient proof that we cannot rely upon nature nor neighbor to safeguard water supplies, unless it be under extremely fortunate conditions.

In 1906 London's death rate was 6, and in 1907, 4 per 100,000 population. Stockholm has had a typhoid fever death rate of 24 for the first five year period beginning 1881, and 15 in the five year period, 1901 to 1905; the death rate was 3 and 2 in 1906 and

1907, respectively, per 100,000 of population. Brussels, Amsterdam, The Hague, Copenhagen, Christiania, Berlin, Breslau, Munich and Vienna show similar low figures. The highest death rate from typhoid fever of the 27 foreign cities mentioned in the 12th U. S. census is found in St. Petersburg, Rome, Milan, Toronto, Belfast, and even there the highest figures which we find for the periods up to 1890 are surpassed by the figures of a very large number of registration cities in the United States for the year 1907.

The reason for the low typhoid fever death rates in Western Europe is simply that surface waters are much more generally filtered than they are here. The laws and regulations, especially in Germany, protecting water supplies, and what is just as important, the enforcement of the laws, are very strict. Filters must show a certain efficiency required by state laws. Rigid sanitary supervision also extends to the milk supply. Oysters are not eaten so generally as here. Secondary causes, such as contagion and the infection from flies, are likewise decreased abroad. There must be, undoubtedly, a good many more factors which influence the mortality figures unfavorably than the water supply. Let us compare the typhoid fever mortality of some of our cities after a filter plant was established up to 1907, with the rate of the 27 foreign cities given the 12th U. S. census for the periods of 1906 and 1907.

DEATHS FROM TYPHOID FEVER PER 100,000 POPULATION.

Providence, R .I., shows		13.7
St. Louis, Missouri (chem. purif.)		19.1
Youngstown, Ohio	"	39.1
Ithaca, N. Y.	"	25.3
Paducah, Kentucky	"	78.7
Watertown, N. Y.	"	38.2
Paterson, N. J.	"	11.9

Out of the 27 foreign cities there were 15 cities with a mortality figure of 10 or below in 1906, and 14 cities in 1907. Figures as low as 2, 3 or 4 were never reached in any of the registration cities here for the period of 1900 to 1907, except in Decatur, Illinois, for the year 1906, Fitchburg, Massachusetts, for 1903 and 1906, and Madison, Wisconsin, for 1905, taking U. S. census figures as a basis.

The technical detail of our filter plants is not at fault, so what is the explanation? It is stated that where the typhoid fever death rate exceeds 20 per 100,000 of population, the public water supply is open to suspicion. Of the above mentioned six American cities, filtering their water supply, four exceed this figure considerably. The average death rate from typhoid fever in American cities is about 35 per 100,000 of population. There are two possibilities, either our sanitation is deficient and the sources of typhoid fever infection, other than the water supply, not as well controlled as in Western Europe, or we have sources of infection unknown abroad. This would force upon us the question of the "residual typhoid," that is, the typhoid rate after the water and milk supply are thoroughly safeguarded, as well as all other sources of infection. Evidence seems to confirm that there is a "residual typhoid," which, according to E. C. Levy and A. W. Freeman, ("Certain Conclusions Concerning Typhoid Fever in the South, as Deduced from a Study of Typhoid Fever in Richmond, Virginia," read at the regular annual meeting of the American Public Health Association held at Winnipeg, 1908), is twice as high in the South as in the North of this country.

To get further information upon the relation of public water supply to general and specific mortality, a circular letter containing questions relating to the water supply, was addressed to 260 cities, which number includes nearly all the registration cities of the 12th census. The information principally asked for was in regard to any change in the water supply since 1890 up to the present day, and in regard as to mortalities, principally from typhoid fever. I have selected the eight year period, 1900 to 1907, for my figures, for the reason that the statistics for this period are likely to be more reliable than the statistics previous to this date. Furthermore, for the reason that the greater part of the improvements in water supplies has been effected since 1900. Of the answers which I received, a good many had to be discarded for lack of sufficient information, and a good many came too late to be considered in this paper. Fifty-nine cities were finally selected, and their information corroborated as far as possible by State Board of Health and municipal reports.

The cities selected are:

TABLE I.

Columbus, Ohio.	Gloucester, Mass.
Massillon, Ohio.	Brockton, Mass.
Cincinnati, Ohio.	Lynn, Mass.
Cleveland, Ohio.	Haverhill, Mass.
Youngstown, Ohio.	New Bedford, Mass.
Elmira, N. Y.	Lawrence, Mass.
Ithaca, N. Y.	Aurora, Ill.
Olean, N. Y.	Erie, Pa.
Corltand, N. Y.	Williamsport, Pa.
Rochester, N. Y.	Carbondale, Pa.
Auburn, N. Y.	Steelton, Pa.
Watertown, N. Y.	Paducah, Ky.
Binghamton, N. Y.	Louisville, Ky.
Buffalo, N. Y.	Newport, Ky.
Memphis, Tenn.	Jacksonville, Florida.
Providence, R. I.	San Antonio, Texas.
St. Louis, Mo.	Sault Ste. Marie, Mich.
St. Joseph, Mo.	Kalamazoo, Mich.
Concord, N. H.	Escanaba, Mich.
Portsmouth, N. H.	Ann Arbor, Mich.
Raleigh, N. C.	Sacramento, Cal.
Wilmington, N. C.	Minneapolis, Minn.
Beloit, Wis.	Duluth, Minn.
Milwaukee, Wis.	Paterson, N. J.
Holyoke, Mass.	Richmond, Va.
Newton, Mass.	Norfolk, Va.
Springfield, Mass.	Wheeling, W. Va.
Taunton, Mass.	New Orleans, La.
Fitchburg, Mass.	New Haven, Conn.
Bennington, Vt.	

Of these cities, the highest general death rate for the period 1900 to 1907, was reached by Raleigh, North Carolina, with 28.5 deaths from all causes, per 1,000 of population. St. Joseph, Missouri, showed the lowest corresponding figure amounting to 7.9% of population. The highest typhoid death rate of the cities investigated for the eight year period was reached by Steelton, Pennsylvania, with 101.9 per 100,000 of population; the lowest being Concord, New Hampshire, with 11.7 per 100,000. 29 out of the 59 cities used unfiltered surface water for the eight year period, as water from reservoirs, lakes, ponds, brooks and rivers. These are:

TABLE II.

Wheeling, W. Va.	Taunton, Mass.
Buffalo, N. Y.	Fitchburg, Mass.
Auburn, N. Y.	Holyoke, Mass.
Rochester, N. Y.	Richmond, Va.
Steelton, Pa.	New Orleans, La.
Erie, Pa.	Cincinnati, Ohio.
Escanaba, Mich.	Cleveland, Ohio.
Sault Ste. Marie, Mich.	Columbus, Ohio.
Wilmington, N. C.	Louisville, Ky.
Gloucester, Mass.	Newport, Ky.
Brockton, Mass.	Sacramento, Calif.
Lynn, Mass.	Minneapolis, Minn.
Haverhill, Mass.	Duluth, Minn.
New Bedford, Mass.	Concord, N. H.
Milwaukee, Wis.	

The average death rate from all causes for the eight year period in these 29 cities was 17.3 per 1,000. Minneapolis, Minnesota, showed the lowest rate, 10.9; Wilmington, North Carolina, the highest, with 27.7 per 1,000 population. The average death rate from typhoid fever for this period was 45.1 per 100,000 population. Concord, New Hampshire, (record up to 1906 only) had the lowest rate, with 11.7; Escanaba, Michigan, the highest rate, with 140.9 per 100,000 population.

Cities using unfiltered ground water supply exclusively for the period 1900-1908, numbered twelve. They were;

TABLE III.

Memphis, Tenn.	San Antonio, Texas.
Beloit, Wis.	Ann Arbor, Mich.
Aurora, Ill.	Kalamazoo, Mich.
Olean, N. Y.	Portsmouth, N. H.
Cortland, N. Y.	Massillon, Ohio.
Jacksonville, Florida.	Bennington, Vt.

The average general death rate for these twelve cities 1900 to 1907, was 16.9. Olean, N. Y., had the lowest rate, with 12.3; Jacksonville, Florida, the highest rate, with 27.8 per 1,000 of population. The average typhoid fever death rate for the same period amounted to 35.4. Beloit, Wisconsin, showed the lowest rate, with 16.9; Jacksonville, Florida, the highest, with 86.4 per 100,000.

A comparison of the typhoid fever mortality figures in cities with unfiltered surface and ground water, quickly shows the superiority of the ground water supply, the proportion being 45.1 to 35.4. The general mortality figures for the ground water supply cities is likewise lower.

The average general death and typhoid fever rate is even lower than the corresponding rates of the four cities which were using continuously filtered surface water for the period 1900 to 1907, viz.: Lawrence, Massachusetts; Norfolk, Virginia; St. Joseph, Missouri; and Raleigh, North Carolina. The average total death rate for the four cities is 18.4 per 1,000 for the eight year period; the average typhoid fever death rate is 43.3 per 100,000 for the same period. The comparatively high general typhoid fever death rate in these cities can, doubtless, be traced to other responsible factors than the water supplies.

Cities which had a typhoid fever death rate exceeding 20 per 100,000 population, in spite of purification, were

TABLE IV.

(Figures Showing Number of Typhoid Fever Deaths per 100,000 After Established Purification Up To 1907.)

Elimra, N. Y.	(44.3)	
Ithaca, N. Y.	(25.3)	
Watertown, N. Y.	(38.2)	
Raleigh, N. C.	(77.7)	
Youngstown, O.	(39.1)	city statistics.
Paducah, Ky.	(78.7)	
Lawrence, Mass.	(22.3)	
Norfolk, Va.	(59.2)	

Cities filtering their water supply up to 1907, with typhoid fever death rates below 20, were:

TABLE V.

St. Joseph, Mo.	(13.1)
Providence, R. I.	(13.7)
St. Louis, Mo.	(19.1)
Paterson, N. J.	(11.9)
Binghamton, N. Y.	(13.4)

Newton, Massachusetts, with a filter gallery, had a very low typhoid fever death rate, 11.9 for the eight year period.

One can best study the effect of the purified water supply upon the general and typhoid fever death rate by tabulating the mortality figures, and calculating the mortality increase and decrease, respectively. This is done in the following table, taking the eight cities which have improved their water supply during the period, 1900–1908.

Of these eight cities, all show a decrease in the general death rate, except, Watertown, N. Y. There is a percentage reduction of typhoid fever death in each case, Ithaca, New York, leading with a reduction of 76.8. The average reduction in the general death rate of these cities is 5.7%. In the typhoid fever death rate it is 53.8.

The general death rate in a large city is likely to undergo yearly variations quite independently from the water supply, still, in the vast majority of cases, a continuous decrease in the general mortality follows an improved supply. In many cases it is possible to prove that the reduction in the general mortality is out of proportion to the death avoided from typhoid fever, that is to say, that there are many saved from avoided cases other than typhoid fever, probably intestinal disorders to the greatest extent. Whipple states that with each typhoid fever death avoided by an improved water supply, two other lives are spared. Let us see to what extent this statement applies to the figures given above. The general death rate is 17.8 per 1,000 of population, the typhoid fever death rate 64.7 per 100,000 of population, before any improvement in the water supply took place. The percentage with which typhoid fever participates in the general death rate is 3.63 (before change of supply).

After change of the water supply, the typhoid fever death rate is 29.9 per 100,000, respectively 1.68% of the total rate from all causes before the water supply was changed. Consequently. there should be a theoretical reduction of 3.63 minus 1.68, which is 1.95% in the general death rate after change of the water supply.

As a matter of fact, the reduction in the general death rate, after the change, amounted to 5.7%; that is to say, the reduction in the general death rate was nearly three times as much as would be expected from the percent reduction of death of typhoid fever.

TABLE VI.

City	General Death Rate Before Change of Water Supply	Same After	Percentage Reduction	Typhoid Fever Death Rate Before Change of Supply	Same After	Percentage Reduction
Providence, R. I.	19.3	19.0	+ 1.6	21.8	13.7	+37.2
St. Louis, Mo.	18.0	16.1	+10.6	39.2	19.1	+51.3
Youngstown, Ohio.	15.6	15.1	+ 3.2	96.1	39.1	+59.4
Ithaca, N. Y.	16.4	15.1	+ 7.9	108.8	25.3	+76.8
Paducah, Ky.	23.4	17.8	+23.9	82.1	78.7	+ 4.2
Watertown, N. Y.	15.5	17.2	—11.1	100.6	38.2	+62.1
Paterson, N. J.	17.2	16.5	+ 4.1	28.2	11.9	+57.8
Binghamton, N. Y.	17.6	17.6	0	40.8	13.4	+67.2
Average.	17.8	16.8	+ 5.7	64.7	29.9	+53.8

The application of these figures in every case would be decidedly wrong, but with a very large number of affirmative statistical results and together with our direct and indirect proof of the prevalence of waterborn diseases, I feel safe in declaring Whipple's statement as to the influence of an improved water supply upon the death rate in general as correct. His statement seems to be well borne out by facts and figures.

There is little which can be said of the other waterborn diseases than typhoid fever, and which can be expressed in comparative figures. Our diagnostic methods are imperfect, and more often is the diagnosis itself, consequently statistical figures on intestinal diseases other than typhoid fever, are of little value when we come to direct conclusions.

Concluding, I wish to say that the underlying lessons have been drawn in this country by statisticians and sanitarians alike, and that rigid state and municipal laws are what is needed most in our present state.

Laboratory Section

THE NEED OF QUANTITATIVE METHODS IN EPIDEMIOLOGICAL WORK.*

By CHARLES V. CHAPIN.

The progress of a science is largely dependent upon the extent to which quantitative methods are employed in research. One reason for the unsatisfactory state of sanitary science is failure to use such methods, a failure due in part to limitations imposed by the nature of the problems, and in part it is to be feared by the inability of investigators to appreciate the necessity for their use.

The neglect of such methods is easy, their application difficult, yet there are some notable instances of their successful employment. The art of filtration of drinking water is dependent upon the quantitative study of the bacteria removed, the rate of flow through the filters, the size of sand grains, the depth of sand and various other factors. When it was first found that typhoid bacilli would live for many months in ice, great alarm was felt, but a quantitative study of the problem has shown that the danger was greatly exaggerated. Careful quantitative determination of the vitality of typhoid bacilli and cholera spirilla in different kinds of water, under conditions as nearly natural as possible, though such experiments have not as yet been so extensive as they should be, are furnishing much practical information. Quantitative studies have shown that sulphate of alumina may be used as a coagulent in drinking water, and sulphate of copper as an algaecide, without harmful results. I remember years ago when copper was found on grapes, the vines having been sprayed with Bordeaux mixture, many tons of the fruit were promptly destroyed in a number of eastern cities, though no serious attempt was made to determine whether

* Read before the Joint Session of the Municipal Health Officers' and Laboratory Section of the American Public Health Association, at Richmond, Va., October, 1909.

the amount of copper likely to be consumed was poisonous. Since then much quantitative work has been done on the alleged poisonous properties of various chemicals commonly added to foods, but apparently the work needs to be continued, for there is as yet no accord as to the effect of some of these substances on the users. The finding of, or failure to find bacteria in sewer air, led for years, to all sorts of conclusions as to the danger from such air, but it is only within a very recent period that the quantitative work of Winslow has permitted a final decision. For years a fierce and wordy battle has raged around the question of the part played by cow's milk in the production of tuberculosis, but it is only recently that any concerted effort has been made to determine the comparative prevalence of the bovine and human types of the bacillus. One of the most striking examples of the value of quantitative methods is the production of the antitoxins which would without such methods be impossible.

There are a number of subjects in which I am particularly interested and in which the neglect of quantitative work seems especially deplorable. Because Cornet caused tuberculosis in guinea pigs by injecting dust from rooms occupied by tuberculous patients, it is assumed that most human consumption is the result of breathing pulverized sputum. In the very numerous experiments that have been made there have been very few measurements of the number of living tubercle bacilli in the air of consumptives' apartments, and in the very numerous inhalation experiments with dust and spray, it is rare that an estimate has been made of the number of bacilli present. It seems to be certain that the breathing of large quantities of some kinds of inorganic dust causes serious disease of the lungs, and it is assumed that the breathing of any dust is injurious. But of course this by no means follows, any more than it follows that because 5 percent of carbondioxid is fatal, 0.05 percent is harmful. The whole subject is sadly in need of thorough quantitative study.

A great burden and expense is placed upon the public because it is believed that pathogenic bacteria, when separated from the body, remain alive long enough, and in such quantities, as to be an important factor in the spread of disease. Numerous tests

show that different kinds of pathogens may survive for days, weeks, or months. But if it is asked how many survive, there is no answer. Of a million tubercle bacilli 10 may survive a month, but perhaps 99 percent die within a week, or within three days or within 24 hours. Who knows? There is another and more practical way of measuring this danger, that is, by animal experiment. But who has allowed guinea pigs to live in an apartment recently occupied by a consumptive and noted the number that die of tuberculosis. Who has tried this experiment one week, two weeks, three weeks and four weeks after the removal of the consumptive, and tried it in clean apartments and dirty apartments? No one that I know of, yet we show models of "lung blocks," and if we do nothing else to "stamp out the great white plague," we at least spray formalin.

The question of carriers too is of the utmost importance in preventive work, and though much has been done in this study, far more remains to be done. We need far more accurate data than are now available as to the number of carriers among different classes of persons, their distribution in relation to the sick, and the persistence, number and virulence of the pathogenic organisms.

There is certainly need of a more extended use of quantitative methods by laboratory men, and they are equally a necessity for health officers by whom they have been much neglected. Vital statistics are generally assumed to represent the results of the most accurate quantitative work, as witness the use of percentages carried to the second decimal. But vital statistics often prove a snare when applied to practical uses. When the chemist wishes to make a careful analysis of a substance, it is imperative that he first take a fair sample. It would be well for the statistician to learn from the chemist, for it is only misleading to compare varying percentages of deaths from diphtheria, typhoid fever and smallpox, in different communities or at different times, unless there is evidence of likeness in the populations or due allowance is made for differences.

There are two other fields in which quantitative methods are neglected by health officers. It is imperative for the epidemiologist to determine the relative importance of the different factors in the causation of disease, otherwise there will be an

enormous loss in misdirected effort. It is not enough to prove that a disease may be caused in a certain way, it is necessary for the health officer to know how much of it is caused in that way. How much typhoid fever is due to milk, how much to water, to oysters, to flies, to contact with other cases, with convalescents, with carriers? How much diphtheria is due to the sick themselves, to members of their families, to convalescents, to carriers in the general population, to fomites? How much tuberculosis is due to infection by milk, by meat, by dust, by mouth spray, by contact, by infected houses? It is indeed difficult to answer these questions, but so it is difficult to measure the undulations of the ether, to determine atomic weights, or estimate the distance of the sun, but these difficulties have not deterred physicists, and chemists and astronomers from enthusiastic devotion to their tasks. Until we, too, measure the factors with which we deal, we will continue to go on with our guesswork methods, and will, as in the past, explain every fall in the prevalence of typhoid fever to our own Herculean efforts, and every rise to Divine Providence, or the house fly, or assuming that the existence of the disease is due chiefly to infected water, we may build an expensive filter system only to find that water was a very minor factor in its causation.

No health department has sufficient money for its needs. Expenditures should therefore be made for what will do the most good. We should in all our work carefully measure the cost and the results obtained. Yet how rarely is this done. There are very many ways in which communities are now trying to fight tuberculosis but I know of no serious attempt to measure or even estimate the efficiency of these methods in relation to their cost. Every city in the land is spending money for disinfection after diphtheria, without ever trying to measure the resulting saving in cases and deaths, yet many of these cities think they have no money to hire an injector of antitoxin. We are crowding our hospitals with scarlet fever cases and crying for more buildings, but who has figured the amount of case prevention and the cost per case, and has compared this cost with the expense of district nursing of home treated cases? We spend thousands of dollars for the ventilation of our school houses, but have not a cent with which to abolish the common

drinking cup. Would it not be a good plan to determine the relative effect of the two measures on the health of the children? We complain that councils do not, in appropriation bills, measure the relative values of the health, fire, police and other departments, but would we not vastly improve our position if we could present accurate measurements of our own work? It is not possible to make preventive medicine an exact science, but it is possible to use quantitative methods in many fields hitherto neglected, and to make at least approximate measurements of the value of our work.

PERIOD OF INCUBATION OF INOCULATION RABIES.*

By B. L. ARMS, M. D.,

Assistant Director of the Bacteriological Laboratory of the Boston Board of Health, Boston, Massachusetts.

During the past few years rabies has been quite prevalent throughout the greater part of the United States.

A paper by Drs. Kerr and Stimson of the Public Health and Marine Hospital Service, read in the section on Preventive Medicine and Public Hygiene, at the last meeting of the A. M. A[1]., shows that rabies, with its total of 111 deaths in man in 30 states and with 534 localities in 39 states from which rabid animals were reported in 1908, is a disease that requires a great deal of attention in order that it may be eradicated.

The Wisconsin State Board of Health Bulletin for April-June, 1909, gives the following table as the average period of incubation:

In man	40 days	Cats	14–28 days
Dogs	21–40 days	Pigs	14–21 "
Horses	28–56 "	Goats–Sheep	21–28 "
Cows	28–56 "	Birds	14–40 "

The laboratory is indispensable in the diagnosis of rabies and when we can find Negri bodies, a positive diagnosis can be given in a very short time, but, not finding the bodies, we must go farther and examine the ganglia for rabic tubercles and, as a last resort, animal inoculations should be made.

Formerly rabbits were used almost exclusively for the diagnosis of rabies, possibly from the fact that they were employed to produce the cords for the Pasteur treatment, now guinea pigs are extensively used. Some of the reasons for the use of pigs are here given: they are cheaper, easier to obtain, easier to handle, it costs less to keep them, they occupy less space and they give satisfaction.

* Read before the Laboratory Section of the American Public Health Association at Richmond, Va., October, 1909.

The question arises how long shall animals be kept before giving a final negative report.

Statements from different laboratories have varied from two weeks to a year, the latter being the practice at this laboratory.

The following figures are from 157 pigs inoculated from March, 1906, to July, 1909, and include all positive animals during that time.

Until late in 1908, we made inoculations from all cases whether Negri bodies were found or not, in order that we might have so much evidence that no one could say the bodies were not pathognomonic.

All inoculations were made in duplicate to give the earliest possible result.

During this time we had 3 pigs which lived 83, 121 and 242 days respectively. In the following table these are omitted from the first column but are included in the second.

TABLE I.

Average time to earliest symptom.....	14.84	17.73
Average time from earliest symptom to death	1.69	2.
Average time from inoculation to death.....	16.53	19.74

All pigs are examined at least twice daily and any symptoms noted. The second table shows the variation in the individual animals:

TABLE II.*

Days	Number of Pigs showing first symptom on designated day	Time in days between first symptom and death	Days between inoculation and death
		19	
1		58	
2		53	
3		18	
4		8	
5		10	
6		5	
7	2	12	
8	4		1
9	8	3	1
10	15		3
11	12		5
12	12		11
13	12		11
14	15		10
15	15		16
16	16		23
17	10		8
18	9		13
19	9		14
20	3		12
21			6
22	5		5
23	1		5
24			4
25	1		
26	1		
29			1
31	1		
32	1		1
33			1
35			1
36	1		
37			1
41	1		
42			
83			1
121	1		1
241	1		
242			1
	156	156	157

*As these figures are taken from animals inoculated into the brain or subdural space, with but one exception, in order to obtain the earliest possible result how much greater must be the variation in the incubation period of rabies in animals bitten at a distance from the brain.

The number of pigs in the first two columns is one short of the total, as one pig, on the 19th day, showed unmistakable signs: excitement, was gaunt, refused food and stood in the peculiar attitude indicative of the early stages of rabies; these symptoms gradually subsided, and a week later had disappeared altogether. There were no further signs until the 79th day, when the same symptoms were noted, which gradually increased, the pig dying 4 days later. Negri bodies were abundant in smears from the Ammon's horn. The mate of this pig died on the 19th day. The material with which these pigs were inoculated had been frozen 79 days before being sent to the laboratory.

The 121 day pig was inoculated into the peritoneal cavity with ¼ c. c. of an emulsion of Ammon's horn, cerebellum and cord from a case showing many Negri bodies in the smear. Two pigs inoculated subdurally from this case died in 16 and 21 days, while this one lived and showed no symptoms that were noted, being found dead.

Smears from the Ammon's horn contained quantities of bodies.

The 242 day pig was spoken of in a paper read before this Association last year.[2]

In view of these figures, it seems to the writer that if animals are kept six months and show no symptoms, they may be reported negative, but such animals should never be used again for the diagnosis of rabies.

1 Journal of the Am. Med. Assn. Vol. liii, No. 13.
2 Am. Journal of Public Hygiene, Vol. xix, No. 3.

REPORT OF THE COMMITTEE ON STANDARD METHODS OF BACTERIAL MILK ANALYSIS.

The Committee on Bacterial Milk Analysis respectfully submits the following report for the consideration of the Laboratory Section of the American Public Health Association.

I.

Historical.

At the meeting of the Laboratory Section of the American Public Health Association in Boston in 1905, at the suggestion of Prof. S. C. Prescott, of the Massachusetts Institute of Technology, a Committee was appointed to study the various methods used for the bacteriological examination of milk and to recommend a uniform procedure. This committee consisted of Prof. S. C. Prescott, Chairman; Dr. W. H. Park, Dr. F. H. Slack, Prof. H. L. Russell, Prof. C. E. Marshall, Prof. H. C. Harrison and Dr. E. C. Levy.

A circular letter asking for information as to existing methods and technique used in bacteriological milk examinations was sent to leading bacteriologists of the United States and Canada. Many of these did not make such examinations, and the replies of others who did, showed wide variations of procedure on most important points, such as plating, composition of media, incubation temperature, length of incubation, etc.

At the Mexico City meeting in 1906, Prof. H. L. Russell, of the University of Wisconsin, was appointed Chairman of the Committee, but in June, 1907, he asked to be relieved of the chairmanship, and by the vote of the Council of the Laboratory Section, Dr. F. H. Slack, of the Boston Board of Health Laboratory, was appointed Chairman.

At the Atlantic City meeting in 1907 the Committee presented a preliminary statement[1], going into the subject matter in considerable detail. Dr. E. C. Levy withdrew as a member of the Committee and Dr. B. H. Stone was appointed in his stead, otherwise the Committee was continued unchanged.

At the Manitoba meeting in 1908 a report of progress was submitted[2] covering some points on which no recommendations were made in the preliminary statement; the Committee was continued without change. The two preliminary reports of the Committee have been favorably received and the technique recommended has been generally adopted. This final report is practically but a restatement of methods hitherto tentatively recommended.

Acknowledgments are due to, and the Committee wishes to express its appreciation of the hearty co-operation and aid given by, the following persons.

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Signed, F. H. Slack, Chairman.
W. H. Park, C. E. Marshall,
B. H. Stone, F. C. Harrison,
H. L. Russell.

II.

Collection of Samples. Technique and Apparatus.

Quantities of Milk Required for Analysis. The minimum quantity of milk necessary for making the ordinary bacteriological examination is ten cubic centimeters. When making examinations for certified milk, if possible a pint or quart bottle should be taken and brought to the laboratory unopened.

COLLECTING APPARATUS. In collecting samples for bacteriological examination it is essential that the sample be taken and kept in such a manner as to prevent either any addition of bacteria from without or multiplication of the bacteria originally present.[3] Bottles, tubes, pipettes, etc. used in the collection of samples, besides being washed, shall be sterilized with dry heat for an hour at about 150° C., or to the charring point of cotton.

In the selection of "certified milk" samples it is recommended wherever possible that an unopened bottle be taken, placed in a suitably iced case and brought at once to the laboratory.

Samples of "market milk" may be collected in the same manner as water samples, in sterile, wide-mouthed, glass-stoppered four ounce bottles; the case in which they are carried being well iced. The principal difficulty encountered in this method is in transferring the sample from the original container to the bottle, and the various string and wire devices by means of which the bottle is immersed in the original container are objectionable both on account of the labor of preparing such an outfit and also on account of the coating of milk left on the outside of the bottle when the sample has been taken.

An apparatus designed for the use of test tubes as containers is recommended as superior to one designed for bottles.[4]

Such a case for carrying the samples may be made of copper with double walls, interlaid with half inch felting, outside measure 19 x 9 x 5 inches, inside 18 x 8 x 4 inches, divided into three compartments, the central one 6 x 8 x 4 inches for the samples, the others each 5 x 8 x 4 inches for ice. When iced and closed a constant temperature of 34° to 36° F. is maintained; salt should not be used with the ice or the samples will be frozen. A layer of absorbent cotton will protect the ice from the air when the box is opened for a few minutes. Bits of this cotton are also useful when taking temperatures for quickly wiping the adhering milk from the thermometer.

The samples are carried in cotton-stoppered test tubes 6 x ¾ inches, the compartment holding eight racks of four tubes each. Holes in the bottom of the partitions allow the water to circulate freely about the lower ends of the tubes.

The test tube racks are made of copper tubing weighted with a strip of lead and padded with rubber. When collecting or plating but one rack or a single tube should be removed at a time and the box closed so the other samples will not be exposed to the outside temperature.

Sterile, straight sided, glass pipettes 18 x 3-8 inches with blunt pipette openings 1-8 inch in diameter at the lower ends are used in transferring the samples from the bottles, cans or coolers to the test tubes; these are carried under the sample case in a detachable copper case 19 x 4 x 3½ inches, adapted for sterilizing and divided into two compartments, the upper one for clean sterile pipettes, the lower for pipettes after use, a sterile pipette being used for each sample.

The use of the test tube for the collection of milk samples is recommended instead of bottles for the following reasons, dependent in most cases on the long, slender shape of the tube.

1. Economy of floor area in the collecting case.
2. The facility for maintaining low temperature by the circulation of the ice water about the lower ends of the tubes, thus giving uniformity in the treatment of the specimens.
3. The case with which all the usual washing, sterilizing and general handling of test tubes can be done, since the test tube is a regular piece of apparatus involving no departure from the routine in all the ordinary manipulations.

With samples kept properly iced in this particular form of case there is practically no change in the bacterial content even for 24 hours, the counts varying hardly more than might be expected in duplicate plates. It is recommended, however, that examination of the samples be proceeded with as quickly as possible after the collections are made.

Identification of Samples. When bottles are used identification numbers should be etched on both bottle and stopper. Test tubes should be labelled or etched and numbered.

A complete record of the samples taken, giving date, time, place, name of party from whom sample is taken, name of collector, temperature of milk, character of original container, (tank, can, bottle), etc., should be written opposite duplicate numbers in a blank book or pocket card catalog, or this informa-

tion may be written on small tags and tied or wired to the corresponding test tube or bottle.

TEMPERATURE. The temperature should be taken immediately AFTER taking the sample for analysis, while the milk is still thoroughly mixed.

If it is desired to take the temperature of "certified milk" this should be done when the sample is taken but from another bottle.

A floating thermometer graduated to the Fahrenheit scale is most convenient and the temperature should be expressed to the nearest degree. It is necessary to standardize the thermometer for at least ten degrees on each side of the legal temperature limit. A quickly registering thermometer should be left for at least one minute in the milk and read as soon as removed.

Representative Samples.—Care should be taken to secure a sample which is truly representative of the milk to be examined.

One of several methods for mixing the milk may be used, comparison having shown the results to be practically the same.[3]

1. Pouring the milk into a sterile receptacle and back.

2. Shaking the milk thoroughly with receptacle turned upside down (this may be done where the can or bottle is tightly stoppered or capped and is not so full as to prevent thorough agitation.)

3. In open tanks in stores it is allowable to stir thoroughly with the long handled dipper generally found in use.

4. Where the test tube collecting case is used thoroughly reliable results are secured by first shaking the can or bottle and then stirring with the large pipette before taking the sample, care being taken to close the upper end of the pipette with the finger so that no milk enters until after mixing, or the pipette may be emptied after stirring before the sample is taken.

5. For certified milk samples it is recommended that on arrival at the laboratory the bottle be opened with aseptic precautions and the milk thoroughly mixed by pouring back and forth between the original bottle and a sterile bottle. Another method is to mix as thoroughly as possible by agitation for two minutes in the original container before opening same.

The interval between collection and analysis.—Generally speaking the shorter the time between collection and examination of milk samples the more accurate will be the results. For

routine work the attempt should be made to plate within four hours of the time of collection.

Too much stress cannot be laid on keeping the samples properly iced during this interval. They should be kept below 40° F., but care should be taken that they are not frozen.

III.

MEDIA. Method of making.[5]

AGAR. The standard medium for determining the number of bacteria in milk shall be agar 1%, reaction +1.5, Fuller's scale, made as follows:

1. Boil 10 grams of thread agar in 500 cc. of water for half an hour and make up weight to 500 g. or digest for 10 minutes in the autoclave at 110° C. Let this cool to about 60° C.
2. Infuse 500 g. finely chopped lean beef for twenty-four hours with its own weight of distilled water in the refrigerator.
3. Make up any loss by evaporation.
4. Strain infusion through cotton flannel, using pressure.
5. Weigh filtered infusion.
6. Add Witte's peptone 2%.
7. Warm on water bath, stirring until peptone is dissolved and not allowing the temperature to rise above 60° C.
8. To the 500 grams of meat infusion (with peptone) add 500 grams of the 2 per cent. agar keeping the temperature below 60° C.
9. Heat over boiling water (or steam) bath thirty minutes.
10. Restore weight lost by evaporation.
11. Titrate after boiling one minute to expel carbonic acid.
12. Adjust reaction to final point desired +1.5 by adding normal sodium hydrate.
13. Boil two minutes over free flame constantly stirring.
14. Restore weight lost by evaporation.
15. Filter through absorbent cotton or coarse filter paper, passing the filtrate through the filter repeatedly until clear.
16. Titrate and record the final reaction.
17. Tube (10 c. c. to a tube) and sterilize in autoclave 1 hour at 15 lbs. pressure or in the streaming steam for twenty minutes on three successive days.

All variations from agar media made as described shall be considered as special media. The above medium is recommended as giving the highest and most uniform counts so far as our comparative work has extended. Methods by which the other media mentioned in this report were made are as follows:

BOUILLON. Infuse 500 g. finely chopped lean meat 24 hours with 1,000 c. c. distilled water in refrigerator. Restore loss by evaporation. Strain infusion through cotton flannel.

Add 1% peptone. Warm on water bath, stirring until peptone is dissolved.

Heat over boiling water, or steam bath thirty minutes. Restore loss by evaporation.

Titrate, adjust reaction to +1% by adding normal sodium hydrate.

Boil two minutes over a free flame, constantly stirring. Restore loss by evaporation.

Filter through absorbent cotton, passing the liquid through until clear. Titrate and record final reaction. Tube, using 10 c. c. to each tube. Sterilize.

AESCULIN BILE SALT MEDIUM. (LIQUID).[6]

Weigh out.
1 or 2% of Witte's peptone.
.5% Sodium taurochlorate (commercial).
.1% aesculin.
.05% Ferric citrate.
100 c. c. tap water.

After steaming 15 to 30 minutes the medium is filtered and filled into test tubes and sterilized (fractional sterilization).

PREPARATION OF AESCULIN BILE SALT AGAR.[6]

The directions for making a liter of aesculin bile salt agar are as follows: Boil until dissolved 15 grams of agar, 2.5 grams commercial bile salt, and 10 grams peptone (Witte) in 1,000 c. c. of distilled water. Neutralize with a normal solution of sodium hydrate. Cool below 60° C., add the whites of two eggs or a sufficient quantity of a solution of albumen, bring to the boil and filter as soon as the albumen has coagulated properly. Try the acidity and neutralize if necessary, and then add to the clear

hot filtrate—1 gram aesculin (Merck) and 1 gram iron citrate scales (Merck). After these substances are dissolved test the acidity with decinormal soda solution. It will be found to be about +0.6, as a solution of 1 gram iron citrate scales in 1,000 c. c. water gives an acidity of +0.56. In case the acidity is too high add alkali until the reaction is +0.6, and if the acidity is too low add more iron citrate until the reaction is +0.6. By following these directions exactly satisfactory and even results will be obtained. We have to emphasize here the different manner of neutralization from that recommended for ordinary media by the Committee on Standard Methods of the American Public Health Association, as the procedure outlined above is absolutely necessary. The main point of our reaction is the forming of the black colored salt in sufficient quantity to form as easily visible field.

LACTOSE (OR DEXTROSE) LITMUS AGAR, made as ordinary agar with the addition of 1% lactose (or dextrose) to the medium just before sterilization. Reaction shall be made neutral to phenolphthalein. If the medium is to be used in tubes the sterilized azolitmin solution shall not be added until just before the final sterilization. If the medium is to be used in Petri dishes the sterilized azolitmin shall not be added to the medium until it is ready to be poured into the dishes.

WHEY AGAR. A liter of fresh skimmed milk at 41° C. is loppered by adding sufficient rennet (about 1 c. c. of liquid rennet in 20 c. c. of distilled water). After the curd is firm it is cut in fine pieces and placed in steam for forty minutes. It is then strained through muslin to remove the curd. The reaction of the whey is adjusted to +1.5 acid with the standardized NAOH and 1% of dry peptone and 1.5% of finely shredded agar is added. It is then placed in the steam for 1 hour. The acidity is readjusted to +1.5%. It is then cooled to 60° C. and clarified with egg. Counterpoised and boiled over a free flame for 5 minutes. Filtered through cotton or a hot, washed plaited filter paper, tubed, sterilized 15 minutes for 3 successive days in steam.

Commercial bile-salt may be obtained from Baird & Tatlock, Cross Street, Hatton Garden, London, England, costing about $2.50 per lb.

IV.

Plating. Apparatus. Technique.

Plating apparatus—For plating it is best to have a water bath in which to melt the media and a water jacketed water bath for keeping it at the required temperature; a wire rack which should fit both the water baths for holding the media tubes; a thermometer for recording the temperature of the water in the water jacketed bath, sterile one c. c. pipettes, sterile petri dishes, and sterile dilution water in measured quantities.

Dilutions—Ordinary potable water, sterilized, may be used for dilutions. Occasionally spore forms are found in such water which resist ordinary autoclave sterilization; in such cases distilled water may be used or the autoclave pressure increased. With dilution water in eight-ounce bottles calibrated for ninety-nine cubic centimeters and in test tubes calibrated for nine cubic centimeters, all the necessary dilutions may be made.

Short, wide-mouthed "Blakes" or wide mouthed French square bottles are more easily handled and more economical of space than other forms of bottles or flasks.

Eight ounce bottles are the best, as the required amount of dilution water only about half fills them, leaving room for shaking. Long-fibre, non-absorbent cotton should be used for plugs. It is well to use care in selecting cotton for this purpose to avoid short fibre or "dusty" cotton, which gives a cloud of lint-like particles on shaking. Bottles and tubes should be filled a little over the 99 c. c. and 9 c. c. marks to allow for loss during sterilization.

The dilutions recommended are 1-10, 1-100, 1-1,000, 1-10,000, 1-100,000 and 1-1,000,000.

For certified milk the 1-100 dilution should be used, while 1-100 and 1-10,000 will usually be found best for market milk.

The 1-10 dilution is prepared by shaking the milk sample twenty-five times and then transferring 1 c. c. of the milk to a test tube containing 9 c. c. of sterile water.

The 1-100 dilution is prepared in the same way, except that a bottle with 99 c. c. of sterile water is substituted for the test tube.

The 1-1,000 dilution is prepared by first making the 1-100 dilution, shaking twenty-five times and transferring 1 c. c. of the dilution to a test tube containing 9 c. c. of sterile water.

The 1-10,000, 1-100,000 and 1-1,000,000 dilutions are made in the same manner by dilutions of 1-100, 1-1,000 and 1-10,000 dilutions, 1 c. c. to 99 c. c. of sterile water.

It is recommended that that dilution be used which will produce about 200[7] colonies to a plate, ranging from 40 to 200; where a 1-10 dilution exceeds this number the 1-100 dilution is more accurate, etc. The number of bacteria present, may, if desired, be approximately estimated before dilutions are made by direct microscopic examination of a properly prepared sediment. Otherwise, it is necessary to make a range of dilutions, thereafter selecting for record the count obtained on that plate which yields between 40 and 200 colonies.

Plating whole milk is unreliable, whatever quantities be used, since the bacteria are not so well separated as in the dilutions, and often, owing to the crowded conditions, only a portion of the bacteria present will develop into visible colonies. Moreover if a cubic centimeter of the milk is used, the turbidity of the jelly due to the presence of the milk hides the colonies present from the eye.

Porous earthenware Petri dish covers are recommended as superior to glass since they absorb the excess moisture.[8] They also have the advantage of being cheaper and more durable than glass; they are easily marked with ordinary lead pencil. With long incubation a tendency of plates with these covers to dry out has been observed by some workers; for ordinary routine work however they are perfectly satisfactory using 10 c. c. of media to the plate and incubating in a saturated atmosphere. These covers should never be washed but always thoroughly dry sterilized before use.

Another method of preventing spreaders is by inverting the dishes and placing in the glass cover of each a strip of sterile filterpaper moistened with one large drop of glycerine. Plates so treated do not dry out as quickly as with the porous tops and the glass ware does not become scratched.

PIPETTES. Straight sides 1 c. c. pipettes are more easily handled than those with bulbs; they may be made from ordinary 3-16 inch glass tubing and should be about 10 inches in length.

PLATING TECHNIQUE.[9] The agar after melting should be kept in the water jacketed water bath between 40° C. and 45° C. for at least fifteen minutes before using to make sure that the agar itself has reached the temperature of the surrounding water. If used too warm the heat may destroy some of the bacteria or retard their growth.

For routine work in cities in order to bring down the actual number of colonies in a plate to about the standard of two hundred, it is well to use a dilution of 1-10,000. To make this dilution use two bottles of sterile water each containing 99 c. c.

Shake the milk sample twenty-five times, then with a sterile pipette transfer 1 c. c. to the first dilution water and rinse the pipette by drawing dilution water to the mark and expelling; this gives a dilution 1 to 100.

Shake the first dilution twenty-five times, then with a fresh sterile pipette transfer 1 c. c. to the second dilution water, rinsing the pipette to the mark as before; this gives a dilution 1-10,000. Shake the second dilution twenty-five times, then with a sterile pipette transfer 1 c. c. to the Petri dish, using care to raise the cover only as far as necessary to insert the end of the pipette.

Take a tube of agar from the water bath, wipe the water from outside the tube with a piece of cloth, remove the plug, pass the mouth of the tube through a flame, and pour the agar into the plate, using the same care as before to avoid exposure of the plate contents to the air.

Carefully and thoroughly mix the agar and diluted milk in the Petri dish by a rotary motion, avoiding the formation of air bubbles or slopping the agar, and after allowing the agar to harden for at least fifteen minutes at room temperature place the dish bottom down in the incubator.

CONTROLS. Plating should always be checked by controls. A blank plate should be made with each series of milk plates for control on the agar, water, air, Petri dishes, pipettes, etc.

For control of the technique of plating, it is recommended that for work on "market milk" duplicate plates be made each day on several samples.

"Certified milk" should always be plated in duplicate and where it is possible it is well to have one man's work occasionally checked by another.

Unless duplicate plates show as a rule approximately the same count the worker should see if there is error in his technique.

Plating should always be done in a place free from dust or currents of air.

In order that colonies may have sufficient food for proper development 10 c. c. of agar shall be used for each plate. In plating a large number of samples at one time, the dilution and transfer of diluted milk to the plates may be done for four or eight samples, then the agar poured, one tube to each plate, then another eight samples diluted, etc.

V.

Incubation and Counting.

Two standard temperatures are recognized.

1. 48 hour incubation at 37° C.
2. Five day incubation at 21° C.

Regulations governing the number of bacteria allowable in milk should direct the method to be used in examination and in all reports, papers, etc., on the bacterial count of milk this factor should be explicitly stated.

Incubators should be carefully regulated. Whatever temperature of incubation may be used it is important that the incubator air should be saturated with moisture; this may be accomplished by either having a depression in the floor of the incubator filled with water or by setting a pan of water on one of the shelves.

Counting. Expression of results. Since minor differences in milk counts are within the working error of the methods and are of no significance in practice, the following scale has been adopted for recording results of market milk examination.

Counts below 50,000 are distinguished by five thousands.

Counts between 50,000 and 100,000 are distinguished by ten thousands.

Counts between 100,000 and 500,000 are distinguished by fifty thousands.

Counts between 500,000 and 5,000,000 are distinguished by hundred thousands.

Counts above 5,000,000 are distinguished by millions.

Therefore only the following figures are used in reporting.

5,000	400,000
10,000	450,000
15,000, etc., to 50,000	500,000
60,000	600,000
70,000	700,000
80,000	800,000
90,000	900,000
100,000	1,000,000
150,000	1,100,000, etc., to 5,000,000
200,000	6,000,000
250,000	7,000,000
300,000	8,000,000, etc., by millions.
350,000	

Counts on "certified" or "inspected" milk shall be expressed as closely as the dilution factor will allow.

The whole number of colonies on the plate shall be counted, the practice of counting a fractional part being resorted to only in case of necessity, such as partial spreading.

Various counting devices have been recommended by different workers. The more simple ones, where the whole plate can be seen at once, are more desirable on account of there being less likelihood of recounting colonies. Colonies too small to be seen with the naked eye or with slight magnification shall not be considered in the count.

VI.

Milk Sediments.

It is probable that within the past five years more research work has been done in relation to the various sediment or centrifuge tests for milk than any other method of examination.

These tests were originally started with the idea of detecting mammitis by noting the increase in the polynuclear cells and have become amplified to such an extent that excepting for certified milk a fairly satisfactory bacterial analysis of milk may be made by these methods alone. Roughly these tests now include (a) Estimation of leucocytes, (b) Estimation of number of bacteria together with morphology of same, (c) Estimation of

foreign matter, dirt, feces, etc. It is however impossible to group them separately under these headings since by some of the methods all of these determinations are made. For the most accurate leucocyte counting the Doane-Buckley test as modified by Russell and Hoffman is recommended, while the Stewart method as modified by Hill and Slack is recommended for routine inspection work.

Leucocytes are present in all normal milks and their number occasionally fluctuates greatly without apparent cause. Milk from animals suffering from udder inflammations almost constantly shows a high leucocytic content and without question is unfit for human consumption.[10]

While there is no point in the milk from a single animal where we can say it passes from normal to abnormal in this respect, enough research has been made to prove that the mixed milk from several normal animals very seldom exceeds 500,000 leucocytes to the cubic centimeter. While healthy cows with no distinguishable lesions may occasionally for short periods pass this limit, such variations are very transient in character and if the mixed milk from several cows shows such high content of leucocytes it raises a suspicion of some abnormal condition.[11]

While a leucocytic count of 500,000 or more to the cubic centimeter in the case of a single animal may be transient and negligible, when found in mixed milk it is sufficient evidence to warrant the exclusion of such milk from the market, until satisfactory veterinary inspection of the herd is made.

Stokes[12] devised a microscopic examination of milk for pus cells and streptococci as a means of detecting the presence of mammitis among cows supplying the milk. Centrifugal sediment from ten cubic centimeters of milk was stained and examined with one-twelfth oil immersion lens. He regarded the presence in the milk of an individual cow of five cells per field of the oil immersion lens as justification for excluding the animal from the herd.

Bergey[13] modified Stoke's method and made extensive examinations of the milk of individual cows. Parallel bacteriological examinations of the milk for both species and numbers supplemented his examinations for cells.

Tromsdorff[14] devised a method which consists in centrifugalizing 5 c. c. of milk in a special centrifuge tube with a lower constricted portion so graduated as to permit of reading off directly the amount of sediment. The mixed milk of cows with sound udders, as a rule, shows sediment varying from traces to .5 c. c. per liter with 1 c. c. per liter as the maximum. Trommsdorff recommends the test as an aid in the detection of chronic mammitis.

Stewart[15] of the Philadelphia Bureau of Health further modified Stoke's method so that it was practicable to use it for the examination of large numbers of samples of mixed herd milk. Stewart describes the apparatus and method as follows:

"This apparatus consists of a circular pan about 12 inches in diameter and ¾ inches deep, containing twenty small glass tubes. The tubes contain 1 c. c. of milk and are filled by means of a small bulb similar to that ordinarily used on medicine droppers. The end of the tube is closed by a small rubber stopper, and the tubes are held in the pan by clamps. This pan is fitted upon the ordinary Beckel water centrifuge and covered with a lid which is held down by a thumb screw. The pan covered in this way furnished a surface of very slight resistance to the atmosphere during its revolution, somewhat on the principle of a child's top."

By the old method the arms of centrifuge containing the milk encountered so much resistance in their revolution that the speed with 15 lbs. water pressure was not more than 1,200 revolutions per minute, while the speed obtained with the new apparatus is from 2,500 to 3,000 revolutions per minute with 15 lbs. pressure. This rapid speed causes sedimentation to occur in less than five minutes. When this is completed the centrifuge pan can be lifted from the motor and the per cent. of cream measured by a graduated scale marked upon the tube. The heavier matter, as the insoluble dirt, pus cells and bacteria, is thrown to the peripheral end of the tub where it adheres to the rubber cork in the lumen of the tube. To examine this sediment the cork is carefully removed and a spread made by rubbing the cork containing the sediment over an area of a square centimeter on a 3-inch by 6-inch glass slide. The proper area of the smear is obtained by placing underneath the slide a scale of circles having an area of

a square centimeter. After the smears are dried in the air without fixation of heat, the preparation is stained by the Jenner blood stain for two minutes, keeping the stain in constant motion. The excess of stain is washed off in water and the preparation is dried in the air. By this blood staining method the pus and blood cells are stained perfectly and the ordinary micro-organisms take the blue stain well.

The stained specimens are examined with a one-twelfth oil immersion objective and a No. 3 eye piece. The character of the bacteria is noted and the average number of pus cells per field is counted. This average number is multiplied by 4,400 since there are about 4,400 fields to a square centimeter as estimated by the stage micrometer. This result is approximately the number of pus cells per cubic centimeter.

Hill & Slack[16] modified the Stewart method by using tubes of a larger bore containing two cubic centimeters, stoppered at each end, centrifugalizing at a speed of 2500 revolutions a minute for 10 minutes and smearing the sediment evenly over 4 square centimeters with a drop of sterile water. The advantages claimed over the Stewart method are:

The tubes are so large that there is practically no capillary action. The time of centrifugalizing is increased. The use of water with the smear allows of a thin even smear, the small amount of material of the same dilution left on the stopper being negligible for all practical purposes.

The number of leucocytes per 1-12 oil immersion field multiplied by 20,000 gives the approximate number per cubic centimeter.

So little of the sediment is seen at once with the high power that it is well to confirm the diagnosis of pus by making a thorough examination of the whole surface with a low power lens, to determine how uniform a smear has been made. By using an eye-piece micrometer ruled in squares, the relation of one square to that of 1-12 immersion lens being previously calculated, a count may be made with the low power lens.

The Doane-Buckley[17] quantitative method of estimating leucocytes is described by them as follows:

"With this method ten cubic centimeters of milk are centrifuged for four minutes in graduated sedimentation tubes, at an approximate speed of 2,000 revolutions per minute. The

cream is lifted out with a cotton swab, care being taken to get as much as possible of the fat. It is then centrifuged one minute more and the cream again removed with a cotton swab. Any fat remaining in the milk interferes seriously with the counting, as, if there are more than a few globules they form a layer on the top of the liquid in the counting chamber, and as the leucocytes settle to the bottom of the chamber, it is difficult to see through the fat. It is only with cows giving milk difficult of separation where this trouble is experienced, and with such animals considerable care is necessary in removing all the cream gathered at the top of the sedimentation tube. The method of removing the fat with cotton is the best one that has occurred to us, and it is the only part of the process that does not operate with entire satisfaction in every instance.

Following the removal of the cream, after the second centrifuging the bottom of the tube will contain a portion of the sediment which is easily seen. This sediment may, in extreme cases of cows suffering from garget amount to as much as one cubic centimeter. Ordinarily it will be considerably less than one-half cubic centimeter. The amount varies considerably with the number of leucocytes, but not absolutely. The milk above this sediment is removed with a small siphon, which can be easily arranged with bent glass tubes drawn to a fine point and supplied with a small rubber end pinch cock. In using the siphon it is better to keep the point near the surface of the milk in the tube in order not to agitate the precipitated leucocytes and draw a number of them off with the milk. The milk in the tube may be siphoned within an eighth of an inch of the sediment in the tube. This will usually be below the ½ c. c. mark. Two drops of saturated alcoholic solution of methylene blue are then added, thoroughly mixed with the sediment by shaking, and then set in boiling water for two or three minutes to assist the leucocytes in taking the color. The contents of the tube can be boiled by holding it directly in the flame, but it has no advantage over the use of the water bath, and it is very likely to break the glass. After heating, some water is added to the tube to render the color less dense. Ordinarily filling the tube to the 1 c. c. mark will be sufficient, and this quantity gives an easy factor for calculating the final results.

In putting this liquid containing the leucocytes into the blood counter considerable care is necessary, owing to the tendency of the leucocytes to sink to the bottom. At this place a capillary tube is used, and the cover glass was held in one hand ready to cover the chamber as soon as the drop was transferred to the counting counter. After placing the glass cover over the chamber, about a minute is allowed the leucocytes to settle to the bottom of the chamber. There are very few foreign bodies likely to be mistaken in counting for leucocytes. Ordinarily the polynuclear leucocytes predominate and the stained nuclei with the unstained surrounding cell show up very distinctly. A few small leucocytes with large nuclei may be found and these may be confounded with yeast cells until the worker becomes familiar with the distinction.

As regards counting we have taken a standard with a cubic centimeter as a basis quantity of milk, though we are of course aware that the corpuscles in the blood are enumerated with a cubic millimeter basis. We adopted the centimeter largely for two reasons. In counting bacteria in the milk the cubic centimeter is always the basis employed. Simply because the leucocytes were derived from the blood seemed to be no reason why the same basis for counting should be employed as was used with the blood, while to the ordinary bacteriological worker to whom this work will fall, if ever adopted to any extent, the cubic centimeter standard would be a little more easily comprehended because more frequently used. The blood counter holds one-tenth cubic millimeter and one-ten-thousandth cubic centimeter. If ten cubic centimeters of milk are used and the 1 cubic centimeter of fluid is in the tube after siphoning, and the coloring matter and the water used to dilute has been added, then the resulting number of leucocytes in the counting multiplied by 1,000 will be the total number of leucocytes per cubic centimeter in the milk. If a total of 75 leucocytes was counted in the chamber there would be 75,000 leucocytes per cubic centimeter in the milk.

In the actual counting under the microscope a square millimeter of the counting chamber will be found to be ruled off into 400 smaller equal squares. This facilitates an accurate and rapid count. Where the number of leucocytes is not great the

entire field can be counted in a short time. Where there is a great number of leucocytes a few squares or sets of squares in different parts of the ruled surface will give approximately the number.

There are occasionally a few variations desirable from these rules, but it may be well to state that the details have been pretty carefully and thoroughly worked over and compared, and it is seldom that short cuts can be made if correct results are desired. The time and speed of centrifuging are placed as low as possible for accurate work. When there is one-half c. c. or more of sediment, it is necessary to use more of the methylene blue for staining, as there will be too great a number of leucocytes to make a satisfactory count in the counting chamber, it is better to add water until there are two cubic centimeters, or sometimes even more in the sedimentation tube.

This method of counting, while long in explaining is in reality short and simple in application. Moreover, it is based on accurate measurements in every detail, and the results are correspondingly reliable."

Savage[18] devised a method similar to that of Doane & Buckley which, like theirs, shows large numbers of leucocytes in the milk of normal cows.

Russell & Hoffman[19] working farther with the Doane & Buckley method have made several modifications and recommend the following procedure:

Collection of Samples. Samples for analysis should be taken from the entire milking of the animal, as the strippings contain a somewhat larger number of cells than other portions of the milk. For the purpose of examination take 200 c. c. in stoppered bottle.

Time Interval between Collection and Analysis. To secure satisfactory results, milk must be examined in a sweet condition. Development of acidity tends to precipitate casein in the milk and thus obscure the examination of microscopic preparations. Samples received from a distance can be preserved for satisfactory microscopical examination by the addition of formalin at the time of collection—a proportion of 1 c. c. to 250 c. c. of milk. Formalin has been found the best preservative to use although it causes contraction of the cells to some extent.

PROCEDURE WITH REFERENCE TO PREPARATION OF SAMPLE.

1. Heating sample.—To secure the complete sedimentation of the cellular elements in the milk, it is necessary to heat the same to a temperature which will break down the fat globule clusters, or lessen the ordinary creaming properties of the milk. Samples should be heated at 65° to 70° C. for not less than ten minutes, or from 80° to 85° where very short periods of exposure (one minute) are given. This treatment causes the more homogenous distribution of the fat globules through the milk, and when the sample is then subjected to centrifugal force, the cell elements are not caught in the rising fat globules, but on account of their higher specific gravity are concentrated in the sediment by centrifugal force.

2. Concentration of cellular elements—Ten c. c. of milk are placed in an ordinary sedimentation tube, and after heating as above directed and subsequently shaking, the milk is centrifugalized twenty minutes at 1,200 revolutions per minute. A hand centrifuge may be employed for this purpose; where available a steam turbine Babcock milk tester may be found more practicable.

NOTE.—This speed maintained for the time mentioned, is sufficient to sediment practically all the cell elements suspended in the milk. In our experience we have found the number of cells in supernatant milk to average only 3½%.

3. Preparing the sample for examination—After centrifugalizing, the cream and the supernatant milk are removed, with the exception of the last ½ c. c., by aspirating with an exhaust pump and wiping the walls of the tube with a cotton swab. After thoroughly mixing the sediment with a glass rod, enough of the emulsion is placed in an ordinary blood counter (Thoma Zeiss pattern) to fill exactly the cell. The preparation is then allowed to stand for a minute or two to permit the cellular elements to settle to the bottom of the cell while the few fat globules in the liquid rise to the surface. This method permits of the differentiation of the cells from the small fat globules, in the liquid rise so that a distinct microscopic observation can be made.

EXAMINATION OF MATERIAL. The preparation is examined in an unstained condition.

NOTE.—Most observers have usually stained the sediment prior to examination, but we have found with the above treatment that the cells may be enumerated quite as well in an unstained condition as a stained condition.

The count is made with a one-inch eye piece and 1-6 objective. Where the number of cell elements exceed 12 or 15 per microscopic field, above referred to, one-fourth of the entire ruled area of the counter, equivalent to 100 of the smallest squares of the cell, are counted. Where the cell elements are less abundant, one-half of the entire area (two to four hundred squares) are enumerated. The average number of cells per smallest square is then obtained, which when multiplied by 200,000 gives the number of cells per cubic centimeter in the original milk; multiplied by four million we have the number of cells per cubic ceniitmeter in the sediment examined. As the sediment represents the concentration of cells into one-twentieth of the original volume of milk taken (10 c. c. to one-half c. c.) this number should be divided by twenty to give the number of cells per cubic centimeter in the original milk.

NOTE.—The above factor of 4,000,000 is obtained as follows: The cubic content of the blood counter represents one-tenth of a cubic centimeter. This volume is divided by means of the ruled scale into 400 small cubes each equal to one four-thousandth of a cubic millimeter, or one four-millionth of a cubic centimeter.

EXPRESSION OF RESULTS. All results should be expressed in number of cells per cubic centimeter of the original milk, and in order to avoid fictitious accuracy, should be given in accordance with the method adopted by the Committee on Standard Methods of Water Analysis, as reported in the report in the Laboratory Section of the American Public Health Association for 1905, page 94.

STONE & SPRAGUE have devised a centrifuge tube for quantitative and qualitative analysis of milk sediment which is practically a combination of the Stewart and Trommsdorff tubes, being a 15 c. c. tube, the lower portion of which is drawn into a finely graduated tube about 1-16 inch in diameter and closed with a rubber stopper.

For this method of examination they claim the following advantages:

"First, it measures more accurately the sediment. Second, smears of the sediment can be made in the same manner as with the Slack tube. Third, the column of sediment tends to become stratified so that the different elements can be easily made out. Fourth, the tubes are much more easily cleaned. With this tube we have been able to detect without microscopical examination, the presence of cases of acute mastitis when the milk was diluted thirty times with normal milk. For ordinary routine work we think that centrifugalization in these tubes, using one-tenth cubic centimeter of a leucocyte sediment to fifteen cubic centimeters of milk, in a filled tube, as a maximin limit, will be of as much value as a count. The character as well as the quantity of the sediment should of course be taken into consideration. A sediment from cases of even slight mastitis practically always having a yellowish or pinkish tinge of pus, mixed with a smaller or larger amount of blood. Microscopical examination usually shows red cells as well as pus cells. This test should of course be supplemented by an actual examination of the herds in every case."

THE MICROSCOPIC ESTIMATE OF BACTERIA. (Slack).[20] "The apparatus and the method for making the microscopic estimate are as follows: The special apparatus for centrifugalizing the milk, modified from one used for leucocyte estimation by Stewart of Philadelphia consists of an aluminum disk and cover, 10 inches in diameter and 5-8 inch in depth, fitted to hold twenty small glass tubes arranged radially. These tubes hold about 2 c. c. each and are closed at both ends with rubber stoppers.

The milk samples are thoroughly shaken, the tubes filled, stoppered, inserted into their proper numbered receptacles in the disk, and centrifulgalized for ten minutes at a speed of from two to three thousand revolutions per minute. Thus in each tube the whole sediment from a known quantity of milk is obtained, and may be spread over a given area. A space about 4 sq. cm. is most convenient, being the right size to allow thorough emulsion of the sediment with a drop or two of sterile water, and to permit drying into a thin even smear. It is convenient to smear a number of samples consecutively on a long glass slide which has previously been correctly spaced with a blue pencil.

To obtain the sediment with the least disturbance, the stopper is first removed from the inner, or cream end, then the tube is held with the cream end downwards, the cream removed with a platinum loop and the milk poured out; lastly, still holding the cream end down, the other stopper is carefully removed with the adhering sediment and the sediment smeared evenly with a drop of sterile water over the space on the glass slide, the stopper being rubbed directly on the glass until the sediment has been transferred. When this is properly done the amount of diluted sediment remaining on the stopper is practically negligible. The smear is then dried with gentle heat and stained with methylene blue.

The microscopic examination of a milk sediment thus easily prepared reveals more than any other single test. It shows the character of the milk, the approximate number and morphology of the bacteria, and the presence of pus or streptococci.

It is not claimed that all the bacteria in the milk subjected to centrifugalization are precipitated into the sediment; but it is claimed that in 99 per cent. of the samples a representative number, is so precipitated, and that this number bears a fairly constant relation to the 1-10,000 dilution plate culture when grown in a saturated atmosphere at 37° C.* for twenty-four hours, 1 per cent. agar being used with a reaction of +1.5.

We may say as a rough estimate, that each coccus, bacillus, diplococcus, or chain in the 1-12 oil immersion field represents one colony in the 1-10,000 plate from the same sample. In most cases the count of a representative field multiplied by 10,000 gives approximately the number of bacteria per cubic centimeter. By the use of this method a good idea of the condition of a single sample of milk can be obtained in less than twenty minutes. Thirty samples can be examined in an hour. At the contractor's receiving station one can easily examine 100 to 200 samples daily, thus keeping close watch over the dairies.

In ordinary routine city inspection only those samples need be plated which are doubtful or above the limit established. In this work the plate would corroborate the microscopic findings

* The method was originally worked out in relation to the 24 hour count at 37° C. The exact factor would have to be figured in accordance with the area of the 1-12 immersion field of the individual microscope. The value of the test lies, however, not in accurate counting so much as in the decisive picture obtained of the character of the milk.

and strengthen the evidence of the court cases. Where plates are to be made the microscopic estimate gives an indication of the proper dilution to use.

VII.

Special Bacteria and Tests for Same.

Pathogenic Organisms. Typhoid and diphtheria bacilli are rarely sought for in milk because it is recognized that although these diseases are often conveyed in milk, the period of incubation is such that by the time the outbreak on a special route is noticed the contagion has usually disappeared from the the milk.[21] Typhoid may be isolated by the use of Lactose bile medium as recommended by Jackson and Melia.[22]

Tubercle Bacilli in Milk.[23] Collection of samples and technique. "Pint or quart samples of milk should be obtained, kept well iced, and delivered to the laboratory as soon as possible. The milk and cream should be well mixed by shaking vigorously. 50 c. c. of the mixed milk are then transferred to a large centrifuge flask and 100 c. c. of sterile water added. Centrifuge for one hour at 2,000 revolutions per minute. The milk was diluted with twice its volume of water with the idea that it would decrease the specific gravity of the milk and so permit of the easier sedimentation of the tubercle bacilli. Guinea pigs are then inoculated, subcutaneously in the belly wall, with 5 c. c. of the sediment thus obtained. The guinea pigs not dying in at least two months are chloroformed, after being tested with tuberculin, and careful autopsies made. Smears, cultures and sections are made from the various organs of the animals that show any change from the normal. The smears are stained with carbol fuchsin and examined for acid fast bacilli.

Cultures are made on glycerinized potato and glycerine agar to rule out Rabinovitch's quick growing acid fast butter bacillus.

Sections are stained with carbol fuchsin for tubercle bacilli and also with haematin and eosin for histological appearances.

Tuberculous guinea pigs may be differentiated from non-tuberculous by giving sufficient crude tuberculin (2 c. c.) subcutaneously to cause the death of the tuberculous animals in twenty-four hours.

Of about 250 guinea pigs tested in this way no animal that did not have tuberculosis died. Two or three that had slight lesions did not die but became sick. It was noted that all the animals died whose lesions had become caseated.

The reaction seems of distinct service in eliminating infections with acid fast organisms and the suggestion is made that with some modification the procedure may have a distinct place as an aid in differentiating true tuberculosis from infections with other acid fast organisms which produce tubercular-like lesions." It is of course understood that the examination of milk for tubercle bacilli is by the very nature of the test limited. For the control of this disease in cattle we must rely upon the tuberculin test.

WISCONSIN CURD TEST.[24] The Wisconsin curd test is conducted as follows:

1. Sterilize milk containers so as to destroy all bacteria in vessels. This step is very important and can be done by heating cans in boiling water or steam for not less than one-half hour.
2. Place about one pint of milk in a covered jar and heat to about 92° F.
3. Add ten drops of commercial extract of rennet and mix thoroughly with the milk to quickly coagulate.
4. After coagulation cut curd fine with case knife to facilitate separation of whey; leave curd in whey one-half hour to an hour, drain off whey at frequent intervals until curd is well matted.
5. Incubate curd at 98° to 100° F. immersing jar in warm water. Keep jars covered to retain odors.
6. After six to nine hours incubation open jars and observe odor, examine curds by cutting with sharp knife and observe.
7. Very bad milk will betray the presence of gas-producing bacteria by the spongy texture of the curd and will have an off-flavor.
8. If more than one sample is tested at the same time, dip knife and thermometer in hot water before each time used."

As a rule milks showing the presence of gas or bad odors in any considerable degree are milks that have been more or less polluted with extraneous organisms or carelessly handled, and as a consequence such milks show a curd filled with pin holes due to

gas. It is not intended that this test should be used for an absolute indication of the presence of gas-producing organisms, but rather it has been of service in the detection of the condition of market milk. It is possible that a milk containing but few bacteria may give a very undesirable curd. In order to obtain a good curd we must either have a milk which contains almost no bacteria or one which contains large numbers of lactic acid organisms. While more valuable in testing milks for cheese making it is useful in the examination of market milk if used with judgment. Work done with this test for the detection of fecel matter shows that positive results can be obtained from other gas formers than *B. coli*. The advantage of the test is that it is simple to perform in the dairies and very quick in its results, determinations being made over night. The disadvantage is that while it is a valuable indicator it is by no means a sure test for fecal matter.

Other methods of detecting gas-producing organisms in milk—Gas producing organisms may be tested for in milk, as in water, with glucose or lactose broth in fermentation tubes. Test similar to presumptive test for *B. coli* in water analysis may be made by inoculating into these broth fermentation tubes a c. c. each of the 1-100, 1-1,000 and 1-10,000 dilutions, or if *B. coli* organisms are to be numerically determined the milk may be plated in lactose litmus agar, red colonies counted and species tests worked out. Lactose-bile medium has also been used for the determination of *B. coli* in milk.

The presence of these gas-producing organisms in abundance usually indicates dirty conditions of stables, cows or vessels. In small quantities they may be found in most milks.

In Baltimore routine examinations are made for *B. coli* in milk in 1-1,000 c. c. of each sample.

One c. c. of the 1-1,000 dilution is placed in ordinary bile containing 1% lactose in a fermentation tube and allowed to stand at 37° for 72 hours, at the end of which time if there is more than 15% gas, plates are made, colonies isolated and run through species tests. Of many hundred examinations the colon bacillus is found in about 25% of the samples in winter and 75% in summer in 1-1,000 of a c. c.

The following table prepared from the results of the routine examination of the Baltimore milk supplies for 1906 shows that the colon bacillus is more apt to be present in milk of high bacterial content.

Number of Bacteria	No. of Samples	*B. coli* present 1-1000 c. c.	*B. coli* absent 1-1000 c. c.
10,000 and under.....	32	15%	85%
50,000 and under.....	92	20%	80%
500,000 and under.....	236	30%	70%
500,000 to 1,000,000.....	64	66%	34%
1,000,000 and over.....	338	72%	28%

Gas Production may be demonstrated by adding to a measured quantity (10 c. c.) of milk in a fermentation tube either 3 c. c. of 5% solution of carbolic acid or 1 c. c. of a sterilized 2% solution of bile salt containing neutral red in sufficient quantity to give the milk a deep pink color. Incubate for 24 hours at 37°. The chemicals evidently inhibit the growth of the lactic acid bacteria. Where neutral red is used if the gas producing bacteria are in large numbers the deep pink of the milk is changed to a canary yellow.

Dextrose litmus agar and lactose litmus agar are of use in differentiating acid formers, the former giving better results.

Whey agar favors the growth of lactic acid organisms, but is unfavorable for other types.

In incubation at 21° C. the addition of 1% lactose to agar has given higher counts than agar without.

Determination of Streptococci.[16] "Although by careful searching a few streptococci will be found in most sediments from pus milk they are seldom found to any great extent by direct microscopical examination. Occasionally a sample will be found crowded with long chains; more often, streptococci, if present, are in the form of diplococci or very short chains.

Where streptococci, diplococci or cocci are found in the sediment and the plate from the same sample contains colonies resembling streptococci colonies, these colonies may be grown in bouillon to see if chains will develop.

First make and record an estimate of the number of such colonies present, then transfer from 10 to 50 of them to bouillon and grow for 15–24 hours at 37° C. To examine the bouillon culture, spread a loopful on a glass slide, fix with heat, fix with alcohol while slide is still quite hot, stain with methylene blue, wash immediately, dry and examine.

Streptococci in small numbers are present in most market milks as shown by Heinemann and many of the short chain varieties are undoubtedly at the time harmless, though by passing through animals their pathogenicity may become marked.[25]

Long chain streptococci are more apt to indicate inflammatory reactions[26] and milk containing these in large numbers is certainly not a safe article of diet.

A milk should not be condemned because a few chains are found together with large numbers of other microscopic organisms in a bouillon culture, but it is safer to exclude a milk from the market when these three tests agree.

1. Microscopic examination of the sediment shows streptococci, diplococci or cocci.

2. The plate from the same sample shows colonies resembling streptococci colonies exceeding a count of 100,000 to a cubic centimeter.

3. The bouillon culture from these colonies shows long chain streptococci alone or in great excess compared with the other bacteria present."

Milk showing in the stained sediment both abundance of long chain streptococci and pus should be condemned as unsafe.

VIII.

Laboratory Procedure on Routine Samples.

The following procedure is recommended for routine work.

1. Centrifugalize, make smeared sediment, stain and examine microscopically for approximate number of leucocytes, approximate number of bacteria, types of bacteria, streptococci, etc.

2. Plate at least those samples, as indicated by the microscopical examination which show bacterial content around or more than the number permitted by the regulation.

3. Incubate 48 hours at 37° C. or 5 days at 21° C.

4. Count colonies.

5. From plates showing numerous pin point colonies transfer ten or more to broth and grow 15–24 hours and examine for streptococci.

IX.

Interpretation of Results.[27]

Bacterial Count. A high bacterial count in milk indicates lack of cleanliness in production, or lack of care after production. Age of the milk is also an important factor and in interpreting results the distance milk has to be brought, etc., should be taken into consideration. Thus a count of 100,000 bacteria to a cubic centimeter should be considered a serious contamination in milk which may be delivered to the consumer within a few hours of production, while a count of no higher than 100,000 in milk produced at a distance and say 24 to 36 hours old is evidence of ordinarily good care. To produce a milk averaging under 10,000 bacteria to the cubic centimeter requires the utmost care and watchfulness of each detail.

Leucocytes.—A leucocytic content of 500,000 or over to the cubic centimeter especially in testing mixed milk should be regarded as suggestive of some inflammatory condition of the udder and the milk excluded until after satisfactory veterinary inspection.

Indication of the presence of pus is more sure if the leucocytes are clumped.

Streptococci. Long chained streptococci are sometimes found in the smeared sediment especially in pus milks, their presence in such smears or when found by the plate method in numbers of over 100,000 to the cubic centimeter should be considered sufficient evidence for exclusion of the milk until after satisfactory veterinary examination of the cows.

B. coli are present in most milks, their presence in large numbers in milk should be regarded as evidence of unsatisfactory conditions at the dairy.

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REPORT OF THE COMMITTEE ON STANDARD METHODS FOR THE EXAMINATION OF AIR.

I. Synopsis.

The most important impurities of air, which it is possible to detect and measure in sanitary investigations, are physical, rather than chemical or bacteriological. The evil effects of heat and humidity upon the human organism are universally recognized. Dust particles injure the throat and lungs and play an important part in predisposing to tuberculosis. Bad lighting exerts an obviously harmful effect upon the eyes. Hence the Committee believes that determinations of temperature, humidity, dust and intensity of light should be fundamental in all sanitary investigations. Standard procedures are recommended for all four of these tests.

Chemical determinations of carbon dioxid in the air, while historically of supreme importance, are held by the Committee to furnish less direct evidence of unfavorable hygienic conditions than do the tests for temperature and humidity and dust, (Gilbert, 1909; Great Britain, 1909). In combination with these latter tests they may, however, be of value, and a standard procedure is suggested. In certain special investigations the determination of the number of bacteria present in the air may also be of interest and a standard procedure is recommended for this purpose.

Other minor questions are discussed in the report, without the recommendation of standard procedures.

II. Physical Determinations.

The principal physical properties of air which it is desirable to take into consideration are temperature, humidity, pressure, dust, light and the velocity of air currents. It would be desirable to include sound and odor, but at the present time it seems impracticable to bring these two important properties of air within the range of exact observation and record.

For most practical purposes it is desirable that analyses of air should show average conditions, that is, conditions which

obtain over an appreciable period of time, as, for example, from thirty seconds to several minutes. In most cases the minute changes in the atmosphere which are constantly occurring are of small consequence to the analyst and can be neglected, except in unusually delicate researches, where special apparatus is required. Fortunately most types of physical apparatus intended for the analysis of air are adapted to register these average conditions, so that the records need no calculation to make them suitable for practical use.

The reason why average conditions are recorded is that the instruments have a lag, which makes the reading occur some time after the occurrence of the conditions which produced it. For most purposes this lag or inertia is of little consequence, but in some instruments it is so great as to be seriously objectionable. For example, some types of thermometers take 15 or 20 minutes to record the temperature when a decided change occurs. This lag may make the reading useless, where a thorough knowledge of the changes is important.

1. Temperature.

For most purposes the temperature of the air can most conveniently be determined by means of mercurial thermometers. These are made in a great variety of forms depending upon the uses to which they are to be put. An accurate and convenient form of thermometer is a naked tube with an elongated bulb of mercury at one end and a ring at the other through which a cord can be tied. The scale in degrees and fractions thereof is etched upon the glass. Thermometers of this type may possess considerable accuracy. Generally they can be relied upon to about one-half to one-fifth of one degree.

It is common to place rod thermometers upon a backing of metal, card or wood, the scale in this case not being etched upon the glass but painted upon the backing. It is perhaps unnecessary to say that thermometers of this type are often more ornamental than accurate. They usually possess a decided lag and are, for this reason, frequently unserviceable. When employed for careful air work thermometers should be suspended freely in the atmosphere or, at least, placed in a current of air sufficient to insure good ventilation about the mercury column.

Registering thermometers are of two principal types—those which record maximum and minimum temperatures and those which make a record of all the changes of temperature that occur. The latter instruments are provided with clock works which move sheets of paper under a pen by which the record is made.

The maximum and minimum thermometer is constructed so as to have a small rod of metal free to move in the tube which holds the mercury. A rising or falling column of mercury pushes the metal rod before it, but leaves the rod upon receding again. When necessary the metal rod is brought to the point of contact with the mercury by means of a small horse-shoe magnet manipulated outside of the thermometer tube. Maximum and minimum thermometers of this type are almost invariably mounted upon a backing and consequently have a considerable lag. They are, nevertheless, serviceable where fluctuations in temperature are not rapid and can be recommended for determining the highest and lowest temperatures, under such circumstances.

STANDARD METHOD FOR TEMPERATURE. For an intelligent understanding of the sanitary condition of any room, car or other enclosed space neither single determinations nor maximum and minimum records are sufficient. Recording thermometers should be used, placed at various selected points and records should be obtained covering a period of several days. Such instruments are of several types. Instead of mercury the contracting and expanding medium is some rigid metal or combination of metals whose contraction and expansion causes a pen point to bear over a moving paper scale and so leave an ink trace. The clock work is generally wound up for a week, for which period the paper scale is also adapted. Scales for recording thermometers are of two principal types—those which are printed upon circular discs of paper, the rising and falling temperatures being recorded by a line which moves at a greater or less distance from the centre, and those upon which the scale is approximately rectangular, with the rising and falling temperatures tracing a line which runs in the general direction of one edge of the paper. For most purposes the latter type of scale is preferable. Among the best of these instruments are those made by Jules Richard of Paris. Scales are printed in either centigrade or fahrenheit degrees. An instrument closely resembling that of Jules Richard is sold by Queen & Co. This type is suggested as a standard.

2. Humidity.

STANDARD METHOD FOR HUMIDITY. Although not always strictly accurate, especially at low temperatures, the most generally useful instrument for determining humidity is the psychrometer or wet and dry bulb thermometer. This instrument is made in several types, that employed by the United States Weather Bureau being simple, efficient and economical. The psychrometers employed by the Weather Bureau are of two principal kinds. In one case the two thermometers with their

wet and dry bulbs are whirled in a vertical plane by means of a small machine actuated by hand power. In the second, which is the most convenient for ordinary work, the thermometers are provided with a suitable handle by which the apparatus is whirled about by the hand of the investigator. The instrument suggested as standard is of the latter (1908) type modified slightly by Soper. It consists of two mercurial thermometers 24 centimeters long, graduated from —10 to 125 degrees Fahrenheit, fastened upon an aluminum back, 1.5 cm. apart center to center. The bulbs project beyond the aluminum back for 5 cm., one of the bulbs being covered with cloth. The upper end of the aluminum back is connected by two loose wire links with a substantial handle by which it can be whirled. The whole is carried in a cylindrical aluminum case. This instrument may be obtained from Schneider Bros., 265 Green St., N. Y., or from Queen & Co. The manner of use is fully described in Bulletin No. 235 of the U. S. Weather Bureau, which contains the full tables necessary for calculating humidity from the wet and dry bulb readings, and is also described in Ward's Meteorology (Ward, 1899).

Stationary wet and dry bulb thermometers mounted, as commonly seen, with a heavy backing are not suitable for the determination of relative humidity, owing to their lag and the likelihood that the wet bulb will not be suitably moistened or ventilated.

The hair hygrometer whose action depends upon the extension and contraction of a suitably prepared hair under the influence of moisture can be made an accurate instrument; and some types are arranged for continuous record. Certain forms of the instrument are open to the same objection which has been raised against thermometers which have a backing; there is difficulty in causing a sufficient current of air to come in contact with them.

3. Dust.

The simplest and one of the most useful methods of determining the amount of dust and its composition is by means of suitable receptacles, such as Petri dishes, upon which the dust is allowed to settle for a sufficient period of time to enable a considerable quantity to accumulate. Particles are then examined under a microscope, or, if desired, they can be swept by means of a camel's hair brush upon a watch glass and weighed.

It is a practicable and desirable procedure to filter air through cotton filters or filters of other material, the quantity of air being measured either by means of a gas meter or other device. Whatever the filtering medium the quantity of air should be large, in order that the quantity of dust may be appreciable in amount and fairly representative in quality. By weighing the filtering

material before and after passing the air through it the aggregate weight of dust in the quantity of air taken for examination can be determined. It is necessary, in most cases, to guard against increase in weight of the filtering material through the absorption of water. This can be done by placing the filtering material in a desiccator before and after filtration and just before weighing in each case.

STANDARD METHOD FOR DUST DETERMINATIONS IN ORDINARY AIR. For very careful work the number of dust particles in the atmosphere can be determined by an instrument invented by Professor John Aitken and called a dust counter. This instrument is expensive; and a somewhat smaller but more generally useful instrument, devised also by Aitken, and called the Koniscope is recommended for standard determinations. The dust counter and koniscope operate upon the principle that dust particles form nuclei upon which moisture condenses and precipitates from a saturated atmosphere. In the dust counter the droplets are counted, in the koniscope the opacity of cloud is estimated. There are not, apparently, many cases in which the dust counter can be turned to practical account in sanitary investigations.

The Koniscope consists of two brass tubes connected at right angles and suitably fitted with stopcocks and a small air pump. By exhausting the air from one of the tubes, allowing the space to become saturated with water vapor by evaporation from wet blotting paper within, and then allowing this moisture to condense upon the dusty astmophere under examination, clouds of different degrees of density can be formed inside the tube. The density of the clouds can approximately be measured by looking through the tube from one end to the other, windows being provided for this purpose. A table is supplied with the instrument to give the approximate number of dust particles corresponding to clouds of different degree of density.

The koniscope can be obtained from Queen & Co. This instrument is easily handled and sufficiently delicate to merit wider use than has yet been made of it in sanitary investigations. It is capable of detecting with great delicacy different currents of air, where the only difference between them lies in the number of dust particles present.

STANDARD METHOD FOR DUST DETERMINATIONS IN AIR HEAVILY LADEN WITH DUST PARTICLES. One of the principal objections to filtration methods in studying the dust in ordinary air lies in the fact that enormous volumes of air must be filtered in order to obtain appreciable results. In factories and other places where the dust is thick the following method is recommended. A measured volume of air is drawn through a filter of granulated sugar, and the sugar is dissolved and the dust suspended in a measured volume of distilled water. The volume taken must vary with the amount of dust present in the air. The sugar should be of the ordinary granulated type with grains between .25 and 1.00 mm. in diameter. The layer of sugar should be 1 cm. deep and may be held in place in a glass tube of 1 or 2 cm. bore by a perforated stopper and square of bolting cloth or by a plug of cotton. The air sample should be collected rather rapidly; for heavily laden air a suction cylinder of metal with a closely fitting piston may be used. Where larger volumes of air are to be examined a Roots blower, operating on the suction principle, can be used to advantage, the quantity of air being measured by a gas meter interposed between the blower and the filter.

The weight of dust present may be determined by filtering the water in which the dust has been suspended through a Gooch crucible. The number of dust particles may be found by the following method (Winslow, 1908): After thorough agitation, one c. c. of the suspension is placed in a Sedgwick-Rafter cell and the particles are counted under the microscope by the method used in the microscopical enumeration of micro-organisms in drinking water (Whipple, 1905). The cell is 50 mm. by 20 mm. in area and 1 mm. deep and the method employed consists essentially in counting the number of particles in representative mm. squares. Both the top and bottom of the cell must be examined to get dusts lighter and heavier than water. Glassware and sugar must be clean and control determinations should be made, to detect any chance pollution.

4. Illumination.

Two general methods are available for the practical determination of the intensity of lighting. The first of these methods depends upon the distance at which print of a given size can be read by an investigator possessing average eyesight. A card of type of different sizes such as is commonly employed by oculists is taken to the point where the light is to be measured and some line of type is selected for the test. The distance at which this type must be held from the eyes in order to be legible is then measured and compared with the distance at which the same type can be seen in unobstructed daylight. The difference between the two distances is taken as a basis of difference in the strength of the illumination.

Standard Method for Measuring Illumination. The second method, which is recommended as a standard procedure, depends on the use of photo-sensitive paper such as can be obtained from any dealer in photographic materials. By exposing the sensitized paper through a slot in a cardboard for a sufficient period of time and noting the number of seconds or minutes consumed to match in depth a standard shade of color the intensity of light can be determined with much accuracy. If a fresh piece of paper is exposed to the direct rays of the sun for three seconds it will assume a shade which can be used as a standard for a given series of tests. The intensity of light at other points may be compared with this by noting the number of seconds required to color a fresh piece of paper from the same lot to the same shade.

5. Velocity of Air Currents.

The velocity of strong air currents is customarily measured by means of recording anemometers. There are so many of these instruments on the market and their use is so generally understood that it seems unnecessary to describe them. Anemometers require a considerable velocity of air and they should never be used without a carefully prepared table of corrections whereby their readings can be adjusted.

It often becomes desirable in sanitary investigations, particularly in studies of ventilation, to determine the strength and direction of currents of air which are too delicate to be measured by means of anemometers. Lighted candles have sometimes been used to show the direction of such delicate air currents, the flame being deflected in the direction in which the current is moving. More delicate than this is the method of noting the course taken by the smoke from a joss stick, cigarette or cigar. For a further discussion of the study of air currents reference may be made to Shaw (1907).

6. Notes on Physical Determinations.

Physical observations of the atmosphere to be of value must not only be made with accuracy and with instruments suitable to the particular tests made, but the observations should be sufficiently numerous to indicate representative or, at least, average conditions at the place under inquiry. One determination of temperature or humidity, for example, is of little service unless it is known that the circumstances under which that determination was made frequently occur. No instrument, of course, is mathematically exact. Each has its error and it is important to learn its error and allow for it whenever failure to do so would affect the value of the results desired. The difficulties of adjustment and uncertainty of results obtained with very delicate apparatus in the hands of unskilled workers make the recommendation of the most refined instruments seem unwise in this place, where practical rather than ultra-scientific methods are desirable.

It is important in using any of the physical instruments referred to here that their accuracy be not over-rated. All instruments employed in sanitary investigations should be thoroughly understood by the investigator using them, and where any considerable importance attaches to the results the instruments should be standardized. To standardize an instrument is to compare it with some other instrument whose accuracy has been demonstrated and its error known. An extensive investigation should be carried on by the help of a special testing station, where all the instruments can be standardized and examined from time to time by a person especially assigned to this work.

In the absence of a testing station or other convenient means of standardizing instruments, apparatus for the physical examination of air can be sent to the Bureau of Standards, Washington, D. C. At that Bureau examinations can be made of thermometers and other instruments and the results reported upon at a nominal cost. Every laboratory and sanitary worker should have a few instruments which have been tested by this or some other laboratory and can be depended upon as accurate enough to be used for comparison.

III. Chemical Determinations.

1. Laboratory Methods for Determining Carbon Dioxide with a High Degree of Accuracy.

Numerous efforts have been made to develop methods of analyzing air for carbon dioxide, applicable to the varying conditions under which the chemist, sanitary engineer or inspector must work. The chemist is called upon to make exceedingly accurate, careful analyses for scientific purposes, while the inspector and engineer are called upon to make estimates and comparisons. It is plain that no one system or method will satisfactorily meet the requirements of all these conditions and therefore in preparing a description of the most satisfactory processes for use as standard methods, the available methods have been classed either as accurate methods or as general tests.

For accurate, scientific work, say, when accuracy to 1-10 of a part per ten thousand is required, the committee recommends as the standard the Patterson apparatus as modified by Sondén, one form of which has been used by Dr. F. G. Benedict of the Carnegie Nutrition Laboratory for over a year, with the greatest satisfaction.*

This apparatus measures a given volume of air, and absorbs the contained carbon dioxide in potassium hydroxide, afterward accurately measuring the remainder, thus giving the carbon dioxide present by volume. The air is measured in all cases at the same pressure and temperature and is measured accurately by means of the readings on a very finely graduated capillary. The principle is simple, but accurate operation requires considerable technique.

*This apparatus will shortly be described in print by Dr. Benedict.

The apparatus may be had by applying to Sondén in Stockholm at a cost of something less than one hundred dollars.

For accurate inspection work, say, one-quarter of a part per ten thousand, the Eimer and Amend form of the Petterson Palmquist apparatus is recommended. This is very similar to the Sondén form but not as delicate. Its cost is about fifty-five dollars.

2. Practical Methods of Determining Carbon Dioxide for Sanitary Purposes.

The time method of Cohen and Appleyard (1894), is recommended as combining practicability and reasonable accuracy in a degree suitable for practical sanitary work.

STANDARD METHOD FOR CARBON DIOXIDE. If a dilute solution of lime water, slightly colored with phenolphthalein, is brought in contact with air containing more than enough CO_2 to combine with all the lime present, the solution will be gradually decolorized, the length of time required depending upon the amount of CO_2 present. The quantity of lime water and volume of air remaining the same, the rate of decolorization varies inversely with amount of carbon dioxide. The method is scientific in principle because it recognizes the fact that the absorption of CO_2 by Ca or Ba hydroxide solution is a time reaction.

Collect samples of air in one-half liter glass-stoppered bottles by any of the methods of collection. Run in 10 cc. standard lime water, replace stopper, and note time. Shake bottle vigorously with both hands until color disappears. Note time required, and ascertain corresponding amount of CO_2 from table.

TABLE.

Time in Minutes to Decolorize Solution	CO_2 per 10,000	Time in Minutes to Decolorize Solution	CO_2 per 10,000
1¼	16.0	3½	6.0
1⅓	13.8	4	5.3
1½	12.8	4¼	5.1
2	12.0	5	4.6
2¼	11.5	5¼	4.4
2¾	8.6	6¼	4.2
3¼	7.7	7½	3.5

3. Rough Methods of Determining Carbon Dioxide.

For the sake of completeness a brief description of the shaker methods of determining carbon dioxide is here included, although their accuracy is not such as to warrant the committee in recommending their use.

The volume of air that must be brought into contact with a definite quantity of lime water, in order to neutralize all the lime, is taken as a measure of the CO_2 in the air. The quantity of lime water and the time of reaction remaining constant, the amount of CO_2 varies inversely as the volume of air. The apparatus consists of graduated shakers either Wolpert or Fitz, and a pipette for measuring 10 c. c. of lime water.

Be sure the plunger of the shaker slides easily, then remove and run into the tube 10 c. c. of the lime water solution. Introduce the plunger, and press it to the top of the solution, then withdraw it to the higher graduation. Close the mouth of the small tube in the Fitz, or the stem of the plunger in the Wolpert with the finger and shake vigorously for 30 seconds. The volume of air brought in contact with the solution is 50 c. c. in the Fitz and 40 c. c. in the Wolpert. Remove finger closing small end, press inner tube or plunger again to top of solution in Wolpert or to T in Fitz, and draw it up as before, thus admitting 20 c. c. fresh air in the Fitz and 40 in the Wolpert. Shake for 30 seconds. Repeat until color is discharged. The first trial will probably give the approximate result, and subsequent tests will aid in giving the correct one. From the volume of air used, the amount of CO_2 can be determined from the table.

TABLE.

Air in cc. Used	CO_2 per 10,000	Air in cc. Used	CO_2 per 10,000
30	28	91	9 bad
36	22	103	8
46	18 very bad	117	7
58	14	138	6
69	12	165	5 good
82	10	207	4

Stoppers and vials should be washed and dried and kept separate and parts of the shaker should be kept separate. In using the shaker see that the fingers are clean. Take care to avoid loss of liquid on addition of fresh air.

4. Methods of Collection.

In the case of the Cohen and Appleyard Method.

Fully as important as the actual test is the method of collecting the sample. For this the committee recommends as standard for more accurate work, the method of collection by water siphon.

STANDARD METHOD OF COLLECTION. The Water Siphon Method. Two bottles (diameter one-third the height), volume about one-half litre, of nearly equal capacity should be fitted with rubber stoppers carrying small glass tubing connected by several feet of rubber connector, with clamps. Fill one bottle completely with water, nearly free from carbon dioxide.

The pair of bottles is taken to the place from which the air is to be collected. The inlet tube may be long to reach to near the ceiling, or short; if long, the first siphoning should be rejected, to secure filling the inlet tube with the air desired, the stoppers exchanged, and the sample taken. The air-filled bottle should be stoppered and taken to the laboratory; or the test solution at once added, and the bottle stoppered and shaken, noting minutes and seconds. One bottle of water with a small reserve will serve for a number of takings before absorbing a deleterious amount of CO_2.

The Steam Vacuum Method may be used as an alternative in less accurate work. The steam is supplied by a 500 c. c. flask serving as a boiler, with a bunsen burner to apply the heat. The flask should be fitted with a rubber stopper carrying a No. 6 glass tube so arranged that one end extends within ½ inch of the bottom of the bottle when placed in position on the stand. The bottles should be of about 500 c. c. capacity, made for a ground-glass stopper but fitted with a rubber stopper.

To prepare the jet, the water in the flask should boil for five minutes in order to expel completely the air in the water and the flask. The pressure should be sufficient to throw the vaporized steam at least 1 foot above the exposed end of the tube.

Place the empty bottle on the stand in an inverted position and allow to remain for three minutes. In the meantime apply a thin coating of vaseline half way up the sides of the stopper. The vaseline acts as an unguent, reducing the coefficient of friction to such an extent that the principal resistance is due to the reaction of the stopper against compression. This enables one

to force the stopper in far enough to bring the glass and rubber into intimate contact, which is essential. The vaseline also fills the interstices between the rubber and the glass, so as to make leakage impossible.

Protecting the hand with a cloth, raise the bottle from the stand, and the instant it clears the end of the tube insert the stopper while the bottle is still inverted. The stopper may be pushed in more securely by pushing it against the table with a few pounds pressure while the bottle is still in the inverted position. Keep the stopper in under this pressure for a few minutes until the vacuum begins to form, after which the atmospheric pressure will keep it in place.

All the bottles required are treated in the same way. The rubber stopper should be at least one size larger than would ordinarily be used for the bottle, and should project three-eighths of an inch or more so as to be easily removed when the sample is to be taken.

Sample bottles may be tested for completeness of vacuum by holding them in an inverted position under water at 70° F., and removing the stopper. After the water has replaced the vacuum, the stopper is inserted and the bottle removed.

5. Solutions.

STANDARD LIME WATER FOR GENERAL TESTS. To a litre of distilled water add 2.5 cc. of phenolphthalein (made by dissolving .7 grams of phenolphthalein in 50 cc. of alcohol and adding an equal volume of water). Stand the bottle of water on a piece of white paper and add drop by drop saturated lime water till a faint color persists for a full minute. Now add 6.3 cc. of saturated lime water and quickly cork the bottle, or connect the pipette.

IV. BACTERIOLOGICAL DETERMINATIONS.

The determination of the number of bacteria in air seems to the Committee to have less importance than was once believed. Disease spread through air is probably due most often to direct pollution with spray from the mouth; and it does not seem possible to measure such pollution in a quantitative way. The total number of saprophytic bacteria often corresponds with the amount of dust present. This is especially true when the dust is not of metallic or other industrial origin. In the examination of the air of barns, dairies, theatres, factories and streets bacterial data may prove of value.

1. Quantitative Determinations: A large number of different pieces of apparatus have been devised which are, after all, simply adaptations of three general methods, viz.:

(a) Filtration of air; (b) Bubbling air through some liquid medium; (c) Precipitating the bacteria from a given volume of air. While each of these methods can be made to give fairly satisfactory quantitative data in the hands of competent workers, nevertheless the committee is of the opinion that the time has arrived when one of them should be adopted as a standard and the others preferably dropped. In adopting a method as standard, the following principles should govern the selection:

(a) Simplicity and inexpensiveness of apparatus.
(b) Ease of operation.
(c) Universal applicability.

Basing judgment upon these considerations and upon numerous comparative tests made for the purpose, (Weinzirl and Fos), the Committee is of the opinion that the filtration method comes nearer to the ideal than either of the other two, and, therefore, that it should be adopted as standard. The apparatus and procedure is described as follows:

STANDARD METHOD FOR ENUMERATING BACTERIA IN AIR. (Filtration method of Petri). The filter tubes are glass tubes 1½ cm. in diameter and 10 cm. long. In the end of each is placed a perforated cork stopper through which a glass tube 6 mm. in diameter is passed. The filter consists of a layer of sand which has been passed through a 100 mesh sieve, 1 cm. deep supported by a layer of bolting cloth covering the cork. Two filter tubes are connected in tandem and a measured volume of air, 10 litres or more, is drawn through at a constant rate by suction. The suction is applied by means of an aspirator of known volume, preferably one of the double or continuous type. Either the Aspirator, Magnus (No. 12,210, $7.50–$9.00), or the Double Aspirator (No. 12,212, $20–$25), both made by Bausch and Lomb are suitable for this purpose. Before using a pair of filter tubes, a test for possible leakage is made by placing the thumb over the cotton stopper and applying the aspirator; if the suction is weak or absent, the corks must be tightened or the tubes discarded. All corks should be tightened and connections wired immediately before using the filters. The collection of the sample should take from 1 to 2 minutes, per liter.

After filtering a definite volume of air through the tubes, the sand is shaken out into 10 cc. of sterile water, thoroughly shaken and aliquot portions plated in ordinary nutrient agar, all plates being made in duplicate. The plates are incubated at room temperature for five days, when final counts are made. If petri dishes 9 cm. in diameter are employed, all plates showing a larger count than 200 colonies should be rejected to eliminate inhibitive action.

A rough idea of the bacterial content of the air may be obtained by the method of exposing plates for definite periods of time and counting the colonies which develop from the germs falling upon them. This procedure is not, however, recommended by the Committee on account of the fact that results are notably affected by varying environmental conditions and are not related to any specific volume of air.

2. Qualitative Determinations: In the study of the bacteriology of sewer air the colon bacillus and the sewage streptococcus may conveniently be used as indices of contamination. Samples may be collected as for the quantitative determination and, after incubating the filtering sand in dextrose broth, must be kept for at least a week and examined daily after three days. Any streptococcus producing a faint growth on agar and coagulating milk may be considered as of human origin.

Gordon (1904) has suggested the use of the similar streptococci found in the mouth as indices of pollution by mouth spray. Your committee (Winslow and Robinson, 1909) has been unable to find such organisms in the air, even under extreme conditions, in sufficient numbers to warrant the recommendation of this test.

C.-E. A. Winslow, Chairman.
Ellen H. Richards,
G. A. Soper,
J. Bosley Thomas,
John Weinzirl.

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REPORT OF COMMITTEE ON STANDARD METHODS FOR CHEMICAL ANALYSIS OF WATER AND SEWAGE.

The Committee begs to present the following report of its work during the past year.

The Committee has made an extensive study of the various methods now in use for the so-called mineral analysis of water. For this purpose samples of a western water rather high in mineral constituents was submitted to about fifteen different laboratories for a complete mineral analysis. It was hoped in this way to establish a basis of procedure which would be satisfactory and accurate. The results, however, have merely demonstrated the unsatisfactory conditions of this branch of water analysis at the present time and the need for a more thorough study of the various determinations. The committee feels therefore that it is not in a position to recommend a definite set of procedures at the present time. It is further recommended that a tentative scheme for analysis be prepared after full consultation with the various workers interested and that the merit of this scheme be again submitted to a practical co-operative test as was done in the first instance. It is believed that a final report can be prepared in time for the next annual meeting. The question of the determination of nitrites in both water and sewage has also been the subject of investigation by three members of the committee. Upon this point also the results are not as yet conclusive and further time must be asked for to complete the work.

At the present time the Committee recommends the adoption of the following changes in the present text of the standard methods report:

1. A complete index to the volume should be prepared. At the head of each page the determinations dealt with on that page should be indicated in the place of the present page headings which serve no useful purpose. This change will greatly facilitate the location of any particular determination without reference to the index.

2. On page 15, omit the words "and microscopical" as it is not believed that samples for microscopical examination can be satisfactorily preserved by disinfectants.

3. On page 16 "Preparation of Silica Standard." It is recommended that precipitated fuller's earth be used in place of diatomacous earth now called for.

4. On page 21, line 19, omit the words "To the Graduation Mark" and substitute the words "to the height equal to that in standard tubes."

5. Page 23, last line. Substitute "Contributary" for "Decisive."

6. Page 26, omit the paragraph beginning "Where they are tabulated together," as it is believed that the addition of non-significant ciphers at the right of significant figures gives as misleading an idea of the accuracy of a number as if digits were used.

7. On page 28, line 25, substitute "5 cc" for "3 cc" and follow this paragraph by the following: "A blank determination shall in all cases be carried out under the exact conditions of the actual determination except that distilled water is used. The actual standardization of the permanganate against the oxalate gives the true strength of the former. The blank gives the relative strength of the two solutions under the conditions of the test. The amount of permanganate used in the determination minus the blank is the amount actually reduced by the organic matter.

8. Page 31, line 15. Omit the words "perhaps 10% on an average" as it is believed upon experimental evidence that this figure is entirely too large.

9. Page 31, line 28, change the paragraph to read "For waters low in free ammonia procedure A shall be followed."

10. Page 34, after Table 6, add the following paragraph: "While the numbers given in the table above serve a useful purpose in indicating the approximate amounts of the two solutions to be employed it is found desirable to make an actual comparison of the standards thus prepared with carefully prepared ammonia standards. Only in this way can the personal equation of the analyst and slight difference in the quality of the Nessler solution be properly compensated. This compari-

son shall be made at rather frequent intervals to assure the permanence of the standards and shall always be checked by each analyst using these standards.

11. Page 38, line 3. Substitute the phrase "which shall be collected" for the present phrase "which if desired may be collected."

12. Page 38, line 16. Add to this sentence after the word "sample" the following clause "and to determine the free ammonia in the distillate." After this paragraph add the following paragraphs:

"The following procedure may be substituted for the above: Determine the free ammonia by direct Nesslerization as described on page 35, and determine the sum of the free ammonia plus the organic nitrogen as described above but without preliminary distillation. The organic nitrogen will then be the difference between the value thus obtained and the free ammonia value."

"It is not consistent to determine the free ammonia by the direct process and on another sample the organic nitrogen after distillation, since by such a procedure a certain amount of nitrogen present in easily broken down compounds will escape detection."

13. Page 39, after Reagent No. 4, add: "No. 5. Fuchsine reagent. A solution containing about 0.1 gram Fuchsine per litre." Also at the end of the procedure the following paragraph: "The nitrite standards made up as described above and allowed to stand ten minutes may as an expedient in routine work be matched by eye by diluting the Fuchsine solution to the required depth of color. For waters high in nitrites and for all sewage work those Fuchsine standards have been found to be sufficiently accurate. A slight error is introduced due to the effect of temperature upon the rate of color production. They are reasonably permanent if kept out of the bright sunlight but should be checked at least once a month against freshly prepared nitrite standard. It has been found in practice that they are more permanent than dilute nitrate standard usually employed."

14. Page 41, last line; after word "water" insert "add several strips of aluminum foil allowing the action to go on over night."

15. Page 44, line 7. Substitute "tared" for "tarred."

16. Page 52, Procedure for Copper only; substitute the following method:

APPARATUS. Platinum dishes of about 100 cc. capacity to serve as anodes. Connection with the circuit is most conveniently made by placing the dish in a little mercury, contained in a shallow metal dish. To the latter is soldered a wire leading to the positive binding post.

A stout platinum wire, about 50 cm. long, 40 cm. of which is coiled into a flat spiral and whose end is fastened directly to the negative binding post. The spiral constitutes the cathode.

A convenient source of electrical current. The character of the current is not so important in this case as in gravimetric processes, since only small amounts of copper are dealt with and the deposit need not be washed or dried. Two "gravity cells" in series, yielding a current through the solution of about 0.02 ampere are satisfactory.

Nessler jars of the short type holding 100 cc.

REAGENTS. Standard copper solution. About 0.8 gram of clean copper sulphate crystals are dissolved in water and, after the addition of 1 cc. concentrated sulphuric acid, the volume is made up to one liter. In 100 cc. of this solution the copper is determined in the usual way by electrolytic deposition and weighing and the solution is diluted so that 1 cc. containing 0.2 milligram copper. This solution is permanent.

Potassium sulphide reagent. An alkaline solution of potassium sulphide made by mixing equal volumes of 10 per cent. potassium hydroxide solution, and a saturated solution of hydrogen sulphide in water.

Nitric acid one to three and sulphuric acid one to one, both tested for copper.

THE DETERMINATION. Of waters carrying from 0.1 to 1.0 part copper one litre is taken. For other concentrations take proportionate amounts. Evaporate to about 75 cc. and wash into the platinum dish. Add 2 cc. of the dilute H_2SO_4 for clear and soft waters. For alkaline waters an additional amount is used to offset the alkalinity. For waters carrying much organic matter or clay, 5 cc. of acid are added to assure the formation of a soluble copper salt. The dish is then placed in position, the

cathode suspended in the solution so that it is parallel to and about half an inch from the bottom, and the circuit is closed. Electrolyze for about four hours with occasional stirring, or over night, if convenient. Lift out the cathode without previously having opened the circuit, and immerse the spiral in a small amount of the dilute nitric acid, previously heated to boiling. Wash off the wire and evaporate the nitric acid solution to dryness on the water-bath. If silver is suspected to be present, add a few drops of hydrochloric acid before evaporation. Take up in water and wash into the Nessler jar. Make up to the mark and add 10 cc. of the sulphide reagent. The color of the copper sulphide develops at once and is fairly permanent, lasting for several hours, at least. A similar tube is prepared by adding 10 cc. of the reagent to a tube of distilled water and then adding standard copper solution in 0.2 cc. portions until the colors of the two tubes match. If one litre of water were originally taken, each cubic centimeter of standard solution used represents 0.2 part per million of copper.

17. Page 59, line 11: "Measure 100 cc. of the water into a 200 cc. graduated flask, add exactly enough $\frac{n}{50}$ sulphuric acid solution to make the water neutral to methyl orange. If a blank determination is made that portion of the water used in the determination of the alkalinity (see page 61) may be used. Boil down a volume of about 30 or 40 cc. to expel carbonic acid and to concentrate the solution. Introduce by means of a pipette 25 cc. of a clear saturated solution of lime water into the test solution and into a blank. Fill with boiled distilled water to about 2 cc. above the 200 cc. mark, mix well, stopper immediately, and cool. When cool titrate an aliquot portion of each solution (which may be obtained by decantation or filtration) with fiftieth normal sulphuric acid using phonolphthalein as an indicator. The difference between the test solution and the blank is equivalent to the magnesium in the original water.

Remark: By adopting this procedure the test solution and the blank are treated in exactly the same manner and the chances are that errors are greatly reduced.

18. Page 62, line 12, omit the words "It is not a reversible indicator, that is".

19. Page 64, lines 29 and 30: page 65, lines 1 and 17, page 66, lines 12, 17 and 20: change "incrustants" to "mineral-acid hardness."

Page 65, line 20: Change "incrusting constituents" to "mineral-acid hardness."

20. Page 66, line 2: "If a blank determination is made the difference between the number of cubic centimeters of sulphuric acid used in the blank and the test gives the mineral acid hardness directly. When the number of cc. used in the tests exceeds the number used in the blank carbonates of sodium or potassium are indicated."

21. Page 67, line 25: "A satisfactory end point cannot be obtained when more than 8 to 10 cc. of the $AgNO_3$ solution is required. Therefore when there are more than 800 to 1000 parts per million of chlorine present and accurate determinations are desired, it is recommended that the chlorine be determined gravimetrically.

Determination of bromine and iodine.* For the quantitative determination of bromine the mixture of evaporated salts is placed in a flask of 250 cc. capacity with 40 grams of potassium dichromate and enough water to make 100 cc. taking the water in which the halogens were first dissolved. The flask is provided with a dropping funnel through which water may be added to keep the volume of solution above 2-3 and not more than the original amount. The flask is also connected to a vertical condenser which condenses the steam and halogens vapors. The haolgens vapors are received at the lower end of the condenser in a 5% solution of potassium iodide. After the mixture has been boiled and the iodine is all distilled 8 cc. of sulphuric acid (equal volume of sulphuric acid and water) is added through the dropping funnel and the mixture is again distilled until bromine no longer comes over. The iodine distilled over and the iodine set free by the bromine which was distilled over are each titrated with $\frac{n}{100}$ thiosulphate solution and the iodine and bromine calculated from the amount used.

* Journal of British Chemical Society, Vol. 49, pp. 682, M. Dechan, also University Geological Survey of Kansas, Vol. 7, pp. 90.

22. Page 72, line 1, omit the words "Because as already explained it is not reversible and indicates only on the alkaline side of the neutral point."

23. Page 73, "Half-bound and bound carbonic acid." It has been found in practice that those terms are misleading and unsatisfactory. It is recommended that the carbonic acid be reported as "free carbonic acid", "carbonic acid as bicarbonates" and "carbonic acid as normal carbonates." This change would involve the following change in the text: Under "Half-bound Carbonic Acid," which heading will now be "Carbonic Acid as Bicarbonates," the text will read: "When the water is acid to plenolphthalein, the carbonic acid as bicarbonates is equal to 88% of the alkalinity when the latter is expressed in terms of calcium carbonate." The third paragraph "Carbonic acid as bicarbonates is present only when the alkalinity by phenolphthalein is less than ½ of that by lacmoid or erythrosine. Then twice the number of ccs. of $\frac{n}{50}$ sulphuric acid required when phenolphthalein is used, subtracted from the number of ccs. of $\frac{n}{50}$ acid used in determining the alkalinity of 100 ccs. of the water with lacmoid or erythrosine (see Page 61) multiplied by 8.8 gives in parts per million the carbonic acid as bicarbonates." Under the heading "Bound Carbonic Acid" which will now be changed to "Carbonic Acid as Normal Carbonates" the procedure will read: "Compute this in parts per million of CO_2 as 44% of the alkalinity by lacmoid or erythrosine expressed in terms of calcium carbonate (see page 61) minus one-half the CO_2 previously determined as bi-carbonates."

24. Page 75. After the first paragraph: "For routine work with waters high in dissolved oxygen it is sufficiently accurate and may be more convenient to pipette 50 cc. of the well shaken sample and titrate as above. Four times the number of cubic centimeters used in titrating gives the oxygen in parts per million.

25. Page 78, omit the procedure here outlined and substitute the following:

"Samples should be collected in glass-stoppered bottles of 150 or 200 cubic centimeters capacity. No special precautions are necessary in collecting samples of ordinarily good effluents that are fairly high in dissolved oxygen. If the dissolved oxygen

is low, precautions similar to those used in collecting dissolved oxygen samples should be observed. A one-tenth per cent. solution of methylene blue, preferably Merck's double zinc salt, is used as indicator. One-half cubic centimeter of this solution is added to each of the samples, which are then incubated, preferably at 20 degrees C., for four days, and observations are made at least once a day. If quick results are desirable the incubation may be made at 37 degrees by adopting suitable precautions to prevent the loss of dissolved oxygen. For this purpose the sample is taken in a bottle fitted with a rubber stopper through which an ordinary medicine dropper is introduced by half its length. Before inserting the stopper into the filled bottle the bulb of the medicine dropper is compressed. As the solution warms up this bulb takes care of the additional volume necessary and prevents the loss of dissolved oxygen. The samples in which the methylene blue becomes decolorized are recorded as having a relative stability corresponding to the time required for reduction, as given below. Those that are blue at the end of four days are given a relative stability value of 95. For more accurate work a longer period of incubation is recommended.

The following table gives the relation between the time of reduction at both 20 degrees and 37 degrees and the relative stability number.

RELATIVE STABILITY NUMBERS.

t20	t37	s	t20	t37	s
0.5	...	11	8.0	4.0	84
1.0	0.5	21	9.0	4.5	87
1.5	...	30	10.0	5.0	90
2.0	1.0	37	11.0	5.5	92
2.5	...	44	12.0	6.0	94
3.0	1.5	50	13.0	6.5	95
4.0	2.0	60	14.0	7.0	96
5.0	2.5	68	16.0	8.0	97
6.0	3.0	75	18.0	9.0	98
7.0	3.5	80	20.0	10.0	99

s—Relative stability or ratio of available oxygen to oxygen required for equilibrium. Expressed in per cent.

t20—Time in days to decolorize methylene blue at 20° C.

t37—Time to decolorize at 37° C.

Theoretical relation—

$$s = 100\ (1-0.794^{t20})$$
$$= 100\ (1-0.630^{t37})$$

A relative stability of 75 per cent. means that the effluent in question contains a supply of available oxygen equal to 75% of the amount of oxygen which the effluent will eventually require before it will have become perfectly stable. The amount of this available oxygen is estimated fairly well by the chemical determination of dissolved oxygen and nitrates. The nitrites are usually so low that they are negligible, and it is unnecessary to decide whether or not the nitrates represent available oxygen, because they have been included in the test and must be considered in the interpretation. Undoubtedly the nitrates will not be used in the stream until the dissolved oxygen of the water has been reduced to a low point. Nevertheless, the fact remains that the available oxygen in the effluent, including the nitrates, is 75 per cent. of that required for equilibrium, and that the remainder must come from the water of the stream, which must also supply enough additional oxygen to replace that which may be abstracted from the nitrates of the effluent, if aerobic conditions are to be maintained. Analyses of water from the stream and estimates of the relative volumes of the stream and the effluent complete the data necessary for a full interpretation.

In general, effluents having a relative stability greater than 90% may be discharged into any stream without danger of their consuming any of the oxygen of the water, because effluents of such high stability will retain oxygen indefinitely on exposure to the air.

For sewages and effluents which have a very low relative stability this test may be employed for another purpose, namely to determine the actual strength of the putrescible material present. For this purpose dilutions with fully aerated tap water are made. The relative proportions of sewage and water to be employed will vary in individual cases and will probably range from one part of sewage to three of water on the one hand, to one to ten on the other. After having established the proper dilution for the sewage in question samples are prepared and treated with methylene blue as already described and the time of decolorization is noted. The relative stability number corresponding to this time refers in this case not to the original sample but to the diluted mixture under investigation. A

stability of 100% would indicate that at the given dilution in a fairly good stream putrefaction would not take place. A relative stability of 50% would indicate that twice the volume of diluting water employed in the test would be necessary in the stream to render the mixture stable.

EARLE B. PHELPS, Chairman.

Franklin C. Robinson

Just as the Journal (May 25) goes to press, the sad news reaches us of the death of Dr. Robinson.

To the American Public Health Association, of which he was a past President; to this Journal, which he served as a department Editor; to the State Board of Health of Maine for which he acted as chemical expert; to Bowdoin College, with which he has for years been connected as Professor of Chemistry; and to the various other official and professional bodies with which he has been associated, his loss will be irreparable.

Broad of mind, sound in logic, careful in judgment, and wise in council, his services have been invaluable. Large hearted and generous, he has constantly and freely given of the best within him.

"To know him was to love him."

The Massachusetts Association of Boards of Health

APRIL QUARTERLY MEETING

Boston, Massachusetts

The quarterly meeting of the Association was held at the Brunswick Hotel, Boylston street, Boston, on Thurday, April 28, under the presidency of Dr Henry P. Walcott.

On the recommendation of the Executive Committee the following gentlemen were elected members of the Association:

Dr. J. R. Hobbie, Chairman of the North Adams Board of Health;

Dr. Everett M. Bowker, of the Brookline Board of Health;

William B. Foster, of the Lexington Board of Health;

Eugene D. Whitehouse, of Boston;

Dr. Willis L. Hale, of the North Attleboro Board of Health;

John F. Twombly, of Brookline;

Laurence B. Reed, of the Plymouth Board of Health;

C. Bertram Thompson, Organizing Secretary, Boston 1915;

Charles Gardner Miles, of the Brockton Board of Health;

Dr. Augustus H. Galvin, of the Salem Board of Health;

John J. McGrath, Inspector of Meats, Salem.

Dr. PALMER. Three years ago this society voted $250 for the dissemination of knowledge in regard to sex hygiene. That money has been expended. We find the work very important, and we desire to carry it on, but the funds of the society do not seem to warrant a further appropriation. Therefore it is necessary to take some other means of getting a fund rather than have the work stop. I move that a committee of three be appointed by the Chair to attempt to raise this money outside of our treasury, and that it be given into the hands of the sub-committee that now has that work in charge. I would like to say to the members present, that if they know of someone who is interested

particularly in this subject and who has the means to give for the purpose it is the sense of this meeting that it is a very worthy cause and that the money would be well spent in this way.

The PRESIDENT. I am sure I can speak for the Association in saying that few subjects of greater importance have come before it, and that the leaflets which have been prepared by this committee have been admirably prepared and have certainly served a very useful purpose.

(Dr. Palmer's motion was adopted by the Association and Drs. Palmer, Chase and Bailey appointed as members of the committee.)

DRY AIR AND ITS EFFECT ON HEALTH.

By W. E. WATT,
Principal, Graham School, Chicago, Ill.

Those diseases which we commonly call children's diseases and which most mothers suppose their children must have are by no means children's diseases. They are diseases to which all persons are subject when their powers of resistance are sufficiently low. Treat any adult as you do an infant—if you can get him to submit to it—and he will take any of the children's diseases. His resistance will become so lowered that he will succumb to the first one whose special microbe assails him.

We contract a disease when our vitality is low, when our powers of resistance are weak, when the antibodies in our system are not numerous enough to cope with the germs which gain an entrance. The impure air we are giving ourselves is the cause of this lowered vitality. We weaken ourselves as surely as does the man who saturates himself from day to day with whisky, and who throws himself in the way of tuberculosis and pneumonia. It is a wonder that so many of that class last as long as they do. But the man who works in a temperature above seventy with the air dry is committing no less a crime against his own nature than the man who takes the whisky. He saps his own strength and any microbe that goes after him may have him.

We have acquired the habit of dying without a struggle. Few put up a fight, as a rule, against the approach of death in these times. We are so fatigued with life that death comes as a relief, and we are quite ready to go. It is rare the physician who attends the man who works indoors when he comes to his last illness finds the man possessed of spirit enough to fight. He simply succumbs. He is weary of life.

We have improved our systems of heating and ventilation until we are afraid of the air. We do not permit ourselves to breathe what God has provided for our refreshment and invigoration. The child comes into the world, the offspring of weakened, nervous, partly broken-down parents. He is born

in a room from which the free air of heaven is excluded. As a rule he never gets any fresh air until he rushes madly out at the smell of it and is spanked back in again for fear he will get pneumonia.

Some mothers have found out that the babe will become strong if placed out on the porch to sleep in his carriage. But they are so lacking in reasoning power that they will not let their two-year-old child sleep out there for fear he will kick off his coverings. And so it is only the infant in arms that gets this intelligent treatment for a little while. Then he is boxed up and coddled until he is peevish, weak, aenemic, nervous, and almost ruined by breathing the air the family procures for its own destruction.

Then he is packed off to the school or the kindergarten where the air supplied is worse than that of the home. It is heated in the basement and forced dry into all the rooms at a temperature declared to be correct. The rules of the board of education call for, say, 68 degrees Fahrenheit. Any teacher who has taught in dry air two years at 68 is chilly in winter when the thermometer registers that temperature. She declares the thermometer in her room is false. She makes trouble enough so the engineer runs the heat to 70 to avoid difficulty with her. After she has had 70 in winter a few seasons she is chilly in 70. The same methods are followed, and she gets 72, then 75, then 80. I know where there are women teaching in 80 regularly and making furious complaint if the temperature falls below that figure. There are certain rooms in every "perfectly" ventilated school which do not work just right. The system is all right, of course, but those rooms are exceptions and we haven't found out just what is the matter, but the teachers who get into those rooms are pleased with the high temperature and make a fuss if it is run down any, and so the school has rooms where the temperature is much higher than the rules of the board permit. Theoretically the rooms are at 68. But in practice they are well up towards 80 at times and in certain parts of the building.

Why are some of us chilly at 70? There are two reasons. In the first place, as everyone knows, evaporation of perspiration takes place insensibly in a dry atmosphere, especially when the

temperature is up, and so a process like that of an ice machine is going on all over our skin. The other reason is less understood but none the less sound. Moisture in the air prevents rapid radiation of heat. When the air is dry we lose heat so rapidly that a chill comes over us. It is owing to the moisture in the air that we are able to live at all, for if there were none we could not make heat rapidly enough to keep alive. Tyndal said that if he could remove the moisture in the air over England for a single summer night, everything that frost could kill would be dead in the morning.

Moisture is required in the air to prevent these chills, and when we try to live in dry air we must have an additional ten degrees of heat to be warm enough, and if we are specially low in vitality we must have more than ten degrees additional. I have found by actual experiment that the well person should not have over 62 degrees of air temperature, but the air should have a humidity of over 50 per cent. I have found also by actual test that a temperature below fifty is far better than 62 if one may wear some extra clothing and exercise a little. Forty is better than fifty if we exercise a little more. My experiments seem to indicate that the lower the natural temperature, provided the person is not feeble, the better it is for mind, body, and soul.

Everyone ought to have as much heat as he wishes. When he says he is chilly his testimony should be taken. It is idle to say a certain employe is a crank and always cold. If he or she complains of chill, it is an honest complaint, and relief ought to be afforded or dangerous results may follow. But there is a way to humidify the air and lower the temperature so that all will welcome the change. They will exclaim over it with joy. They lose the headache, the catarrh, the drowsiness, the liability to err, the testiness of temper, the habit of brooding over real or imaginary injuries, when they get into right air. Right air is low in temperature and rather high in humidity in cold weather.

But far worse than being uncomfortable in hot dry air, far worse than being chilly and getting temporarily ill, is the result of living in hot dry air, for it has a deadly effect on the human body.

Let me first prove to you that the air of your school room is drier than that of the driest desert on the face of the earth.

Air at zero taken from outdoors, has less than half a grain of moisture in the cubic foot. Warm that air to 80 and it requires twenty-two times as much moisture to make it similar to natural air in humidity. This comes about because the moisture in the air, I mean true steam, for that is what it is even at zero,—the moisture in the air contracts when heated instead of expanding as does the air. It shrinks rapidly and there is created in the air a steam vacuum.

If the air as it enters the building is at 100 per cent. of saturation, when it is heated to 80, as happens in your schools sometimes perhaps by accident, but it happens,—when heated to 80 it is no longer at 100 per cent. of saturation but at one-twenty-second of that per cent., or less than 5 per cent. of saturation.

Think of it! The air in that school is at 5 per cent. of saturation on a zero day and the air that kills the hardiest cactus God sets out on the most neglected portion of his footstool,—the desert air, stands at about 28 per cent. of saturation! And your children are put into such a place to be educated!

In my school we have open air rooms the year round. We have also a lower temperature than you have in Boston. We found that a steam jet in the warmed air makes it natural and comfortable to all at ten degrees less of temperature.

In rooms of humidified air at 62 to 64 we are clear headed and feel well. When the new air was introduced it cut down the number of cases of office discipline 80 per cent.

There is less stupidity, strife, vituperation, and insanity where the air is right.

Humidified and cooler air saves one-fifth of the coal as well as adding vitality and efficiency.

We must get it into our schools, our homes, our offices, our churches, and our saloons.

The curse of bad air is the greatest public enemy. Getting rid of it is a problem easy to solve.

BOSTON AND CHICAGO DEATH RATES.

By WM. H. DAVIS, M. D.,
Vital Statistician, Boston Board of Health.

Within the last decade the death rate of Chicago has ranged between 13.62 and 15.43, while that of Boston has never been below 17.75, and at the high point was 20.82.

Why this comparatively high rate for Boston?

Is the reason to be found in the age distribution of the population, in the peculiar type of that portion of the population which is of foreign parentage and in the large number of deaths of non-residents?

Turning to the 1900 Census as the latest source of reliable populations for comparative study, I will first endeavor to show how great an influence this difference in age distribution, color, and parent nativity has upon the death rates of the two cities.

Taking first the Registration Area in which the parent nativity of decedents was reported, representing a population of over twenty million people, death rates were figured out for the following six age periods—under 5 years; 5 to 15; 15 to 25; 25 to 45; 45 to 65; and 65 years and over; both for the colored population and for the following eleven divisions of the white population: those having mothers born in the United States, in Ireland, in Germany, in England and Wales, in Canada, in Scandinavia, in Scotland, in Italy, in France, in Russia and Poland, and in other foreign countries.

Throughout this comparison those of unknown parentage have been classified with those having mothers born in the United States, and those of unknown age have been placed in the age period 25 to 45.

The death rates for these various divisions of the population of the Registration Area are shown in Table I, (p. 383).

I would especially call your attention to the very high rates of the Irish, the Italians, and the colored.

The second table (p. 384) gives the percentage composition of the population of the two cities by color, by age periods, and by birth-places of mothers—the heavy type referring to Chicago.

Notice again in this second table the comparatively high percentages in Boston of those having Irish and Italian mothers.

Multiplying the rates in the first table by the populations in Boston of each age period and of each mother nativity, a series of products is obtained. These products added together represent the number of deaths which Boston would have had in the Census Year of 1900 if the death rates of the registration area had prevailed in Boston.

Similarly for Chicago—multiplying the rates in Table I by the populations in Chicago of each age period and of each mother nativity, another series of products is obtained. These products added together represent the number of deaths which Chicago would have had in the Census Year of 1900 if the death rates of the registration area had prevailed in Chicago.

From these theoretical totals of deaths the theoretical death rates of the two cities were obtained and were as follows:

Boston, 16.64
Chicago, 14.35

With equal percentages in each division of the populations of the two cities in Table II the theoretical death rates of the two cities would have been the same. Therefore the difference between these two rates, namely 2.29 per thousand population, represents approximately the correction which should be added to Chicago's rate, for color, nativity, and age distribution whenever the rates of the two cities are compared.

Another important correction is that needed for deaths of non-residents. For example, last year in Boston there were in all 11,058 deaths, 1,304 of which were non-residents or 11.8% of all deaths; while in Chicago with total deaths of 31,300 there were only 877 deaths of non-residents or 2.8% of all deaths.

In Boston over 82% of these deaths of non-residents occurred in Hospitals and Institutions, and the deaths of non-residents actually raised Boston's death rate last year 2.10 per thousand population, so that if the non-residents had gone home to die Boston's death rate would have been 15.65 instead of 17.75; or, putting it in another way, if the deaths of non-residents had affected Chicago as much as they did Boston, Chicago's death rate would have been raised 1.71.

Assuming that these corrections were constant during the last ten years, and taking Boston as the standard, Chicago's corrected rates are shown in Table III and are indicated in the accompanying chart by the dotted line.

Brief mention may be made of three other corrections which have not been included in this table and chart, but which should not be forgotten.

First—the correction for imperfect registration of deaths. The registration of deaths in Massachusetts was known to be so complete that the Massachusetts census enumerators in 1900 made no attempt to ascertain the deaths of the census year, but in Chicago such an enumeration was made with the result that about 1700 deaths were found which had not been recorded.

Moreover, to quote from the Census:

"As the enumerators did not report more than 50% or 60% of the deaths, the presumption is strong that the omissions in the registration record were even greater than indicated."

Now is it not reasonable to suppose that, had the enumerators found all of the deaths upon the Chicago registration record, they would have found a corresponding proportion of omissions for the other 40% of the deaths. If such be the case the true number of deaths in Chicago for the Census Year was about 28,313, instead of 25,373 credited to Chicago by the local registration records, and the crude rate would have been 16.67 instead of 14.94. And adding to this the corrections already found for non-residents, age, color and parent nativities, the Chicago rate for the 1900 Census Year would have been 20.66 as compared with Boston's rate of 20.84.

Another point not to be forgotten is that Chicago had no 1905 census, so that its present population is estimated upon the increase between the census of 1890 and that of 1900. If Boston's population for 1909 had been estimated in the same way it would have been 662,065 instead of 622,970, and the death rate would have thus been lowered from 17.75 to 16.70.

Slightly in favor of Chicago, however, is the needed correction for sex distribution. This correction is about .05 per thousand population, so that the previously mentioned 1900 corrected rate of Chicago of 20.66 if corrected for sex distribution would be lowered to 20.61.

So much for the general death rates of the two cities and the necessary corrections.

Perhaps more interesting for those interested in Board of Health work would be a comparison of the death rates "from causes directly affected by sanitation and preventive medicine." For this comparison I have taken the diseases used under this heading by the Chicago Board of Health, namely: Asiatic Cholera, Consumption, Diphtheria and Croup, Diarrhoeal Diseases, Smallpox, Scarlet Fever, Malaria, Whooping Cough, Measles, Typhoid Fever and Typhus Fever.

The corrections for age distribution, color and parent nativities have been worked out exactly as were those for the general death rates—taking in the Registration Area the deaths from this group of diseases for each age period of each mother nativity, and dividing by the corresponding population, thus securing a series of death rates for this class of diseases in the Registration Area; then multiplying these rates by the corresponding populations in each city theoretical totals of deaths were obtained from which were calculated the death rates of 4.57 for Boston and 4.15 for Chicago. The difference .42 is the needed correction for color, age distribution and mother nativities. Of Boston's 1304 deaths of non-residents last year 284 or 22% belonged in this group of diseases. As it was impossible to obtain from Chicago any detailed statement as to the causes of their non-resident deaths, I have been obliged to assume that Chicago, like Boston, had 22% of their non-resident deaths in this group of diseases. Thus estimated the correction for non-residents was .37 per thousand population in favor of Boston.

The crude death rates and these corrections are shown in Table IV (p. 386), and in the accompanying chart the dotted line shows the corrected rates for Chicago, Boston being used as the standard.

Finally I wish to call your attention briefly to the infant mortality of the two cities. Any comparison of this age period must be at the best only approximate because on the one hand there is a very imperfect registration of births in Chicago—about one-half the births being recorded—and on the other hand it is well known that any census enumeration of children under one year is unreliable.

Simply for a rough comparison, however, I have plotted out the curves of infant mortality per thousand population of children under one year. For 1900 the census populations are used and for later years the estimated populations have been found by the Chicago method which in brief is to note what per cent of the whole population are children under one year in the 1890 census and again in the 1900 census and then to maintain the rate of increase or decrease in this percentage in making estimates for the succeeding years.

Table V (p. 387), gives the death rates under one year in the Registration Area and the populations of Boston and Chicago under one year by color and by birthplaces of mothers, according to the 1900 census. This table again plainly shows that most of the immigrants who die early and often choose Boston for a home while the more hardy races move on to Chicago.

Of the deaths of non-residents in Boston last year 183, or 14%, were children under one year.

Using now Boston's percentages of populations under one year as the standard, and assuming that 14% of Chicago's deaths of non-residents were under one year, corrections have been made in Chicago's curve for color, mother nativities and non-residents just as in the other charts.

The corrections for color and nativities amounted to 15.53 while that for non-residents was 912, making a total of 24.65 to be added to Chicago's crude rate.

From the corrected rates as shown by the dotted line in Table VI, it would seem that Boston had had the better of the argument during the last five years, but here as in all other calculations so far away from the last census, too great caution cannot be used in making deductions.

The following conclusions, however, can be drawn with absolute safety, that Boston's death rates are comparatively high, because of the age distribution of its population, because of the peculiar type of that portion of its population which is of foreign parentage, and because of the large number of deaths of non-residents.

TABLE I.

DEATH RATES IN THE REGISTRATION AREA BY COLOR, BY AGE PERIODS AND BY BIRTHPLACES OF MOTHERS (1900 CENSUS).

	Under 5	5 — 14	15 — 24	25 — 44 + the Unknown	45 — 64	65+
FOR WHITES ONLY. MOTHERS BORN IN						
United States	42.96	3.67	5.02	6.94	14.56	65.90
Ireland	56.11	4.54	7.48	13.50	30.63	96.86
Germany	47.60	3.70	4.83	8.44	20.33	81.75
England and Wales	44.19	3.64	4.59	7.71	18.34	81.06
Canada	54.92	3.64	5.43	7.63	15.70	68.43
Scandinavia	36.98	3.71	5.66	8.13	16.95	67.27
Scotland	37.01	3.30	4.51	7.99	18.84	84.61
Italy	80.69	4.92	6.65	7.96	17.25	66.14
France	67.67	3.27	4.47	8.78	19.17	74.44
Russia and Poland	42.05	2.50	3.43	5.58	15.24	61.04
Other Foreign	56.60	3.00	5.39	8.62	20.21	79.97
COLORED	118.54	9.76	15.61	18.72	36.71	108.64

TABLE II.

PERCENTAGE COMPOSITION OF THE POPULATIONS OF BOSTON AND CHICAGO BY COLOR, BY AGE PERIODS, AND BY BIRTHPLACES OF MOTHERS (1900 CENSUS).

	Totals		Under 5		5 — 14		15 — 24		25 — 44		45 — 64		65 +		Unk.	
	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.
FOR WHITES ONLY MOTHERS BORN IN																
United States....	30.05	26.44	3.37	3.93	5.54	6.53	5.41	5.22	9.10	7.61	5.00	2.58	1.60	.56	.033	.014
Ireland.....	31.14	12.09	2.58	.84	4.03	1.58	5.24	2.04	13.03	5.33	5.05	1.88	1.15	.40	.056	.019
Germany.....	4.26	22.98	.33	1.90	.68	4.39	.73	4.26	1.64	8.36	.70	3.33	.18	.73	.003	.012
England & Wales	4.24	3.75	.34	.22	.65	.53	.67	.60	1.64	1.56	.77	.70	.16	.14	.006	.004
Canada.....	12.59	2.72	1.35	.24	2.20	.57	2.68	.62	4.84	.97	1.29	.28	.21	.04	.016	.001
Scandinavia.....	1.93	9.50	.24	1.06	.32	1.95	.31	1.58	.83	3.62	.20	1.09	.03	.19	.003	.008
Scotland.....	1.84	1.42	.12	.08	.22	.18	.26	.22	.79	.61	.36	.28	.09	.05	.002	.001
Italy.....	3.65	1.57	.59	.27	.77	.37	.63	.24	1.27	.51	.35	.15	.04	.02	.001	.005
France.....	.35	.42	.02	.01	.03	.04	.05	.07	.15	.19	.08	.09	.02	.02	.001	.001
Russia & Poland.	5.19	8.70	.85	1.49	1.28	2.25	1.08	1.62	1.53	2.55	.41	.68	.04	.11	.002	.004
Other Foreign...	1.66	8.00	.18	1.05	.29	1.87	.31	1.56	.64	2.53	.20	.85	.04	.14	.002	.004
Unknown.....	.70	.57	.03	.02	.05	.04	.07	.06	.15	.18	.05	.05	.01	.01	.341	.213
COLORED.....	2.29	1.86	.17	.10	.23	.19	.41	.35	1.09	.95	.32	.23	.04	.03	.027	.009
TOTALS ..	.....	.....	10.17	11.21	16.29	20.49	17.85	18.44	36.70	34.97	14.78	12.19	3.61	2.44	.493	.295

TABLE III.

DEATH RATES OF BOSTON AND CHICAGO.

Year	Death Rates		Chicago's Rate Corrected for Color, Ages, Nativities and Nonresidents
	Boston	Chicago	
1900	20.82	14.68	18.67
1901	19.90	13.88	17.87
1902	19.11	14.54	18.53
1903	18.28	15.43	19.42
1904	18.28	13.62	17.61
1905	18.49	13.67	17.66
1906	18.95	14.18	18.17
1907	19.18	15.25	19.24
1908	19.11	14.10	18.09
1909	17.75	14.07	18.06

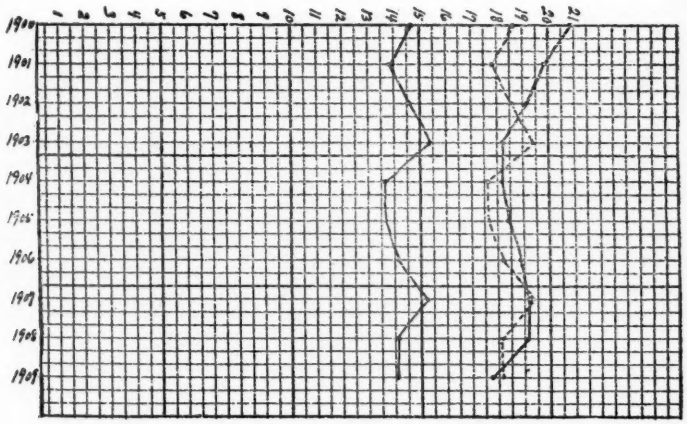


TABLE IV.

BOSTON AND CHICAGO DEATH RATES FOR A GROUP OF DISEASES DIRECTLY AFFECTED BY SANITATION AND PREVENTIVE MEDICINE.

Year	Death Rates		Chicago's Rate Corrected for Color, Ages, Nativities and Nonresidents.
	Boston	Chicago	
1900	5.46	3.96	4.75
1901	5.17	3.58	4.37
1902	4.75	3.90	4.69
1903	4.18	3.85	4.64
1904	4.09	3.31	4.10
1905	3.78	3.66	4.45
1906	3.77	3.74	4.53
1907	3.33	4.00	4.79
1908	4.16	3.89	4.68
1909	3.74	3.78	4.57

DISEASES DIRECTLY AFFECTED BY SANITATION AND PREVENTIVE MEDICINE.

Asiatic Cholera.
Consumption.
Diphtheria and Croup.
Diarrhoeal Diseases.
Smallpox.
Scarlet Fever.
Malaria.
Whooping Cough.
Measles.
Typhoid Fever.
Typhus Fever.

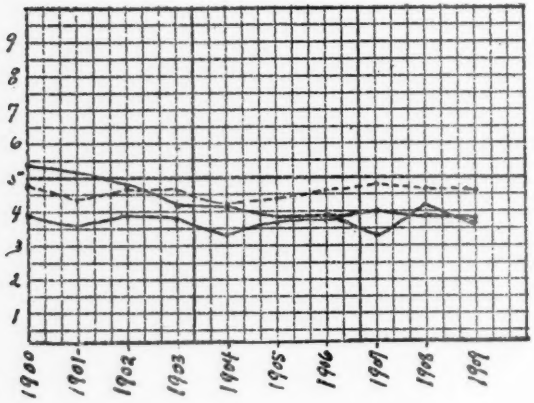


TABLE V.

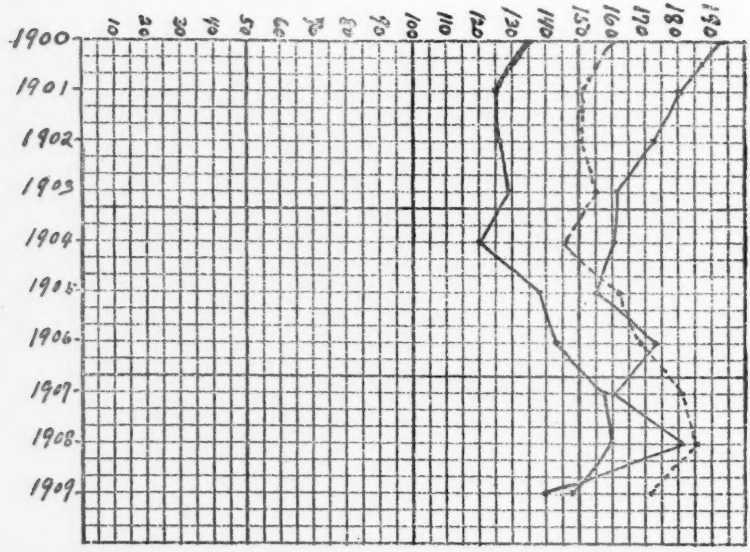
DEATH RATES UNDER ONE YEAR IN THE REGISTRATION AREA AND POPULATIONS OF BOSTON AND CHICAGO UNDER ONE YEAR BY COLOR AND BIRTHPLACES OF MOTNERS (1900 CENSUS).

Color and Birthplaces of Mothers	UNDER 1 YEAR		
	Death Rates in the Registration Area	Populations	
		Boston	Chicago
WHITES:			
United States	141.8	4,092	14,360
Ireland	169.5	3,193	2,954
Germany	159.0	366	6,039
England and Wales	149.3	395	723
Canada	183.7	1,653	834
Scandinavia	113.6	303	3,504
Scotland	120.2	122	243
Italy	189.2	843	985
France	244.9	22	50
Hungary	113.4	23	233
Bohemia	142.5	2	2,110
Russia	133.7	819	1,322
Poland	111.7	193	4,336
Other Foreign	183.0	208	1,246
Unknown	——	26	110
COLORED	371.5	213	326
TOTALS	165.4	12,473	39,375

TABLE VI.

BOSTON AND CHICAGO DEATH RATES OF CHILDREN UNDER ONE YEAR PER 1,000 POPULATION UNDER ONE YEAR.

Year	Death Rates		Chicago's Rate Corrected For Color, Nativities and Non-Residents
	Boston	Chicago	
1900	193.22	135.64	160.29
1901	179.34	125.91	150.56
1902	172.86	126.49	151.14
1903	162.59	129.54	154.19
1904	161.37	120.95	145.60
1905	156.24	138.82	163.47
1906	172.47	144.14	168.79
1907	160.60	157.22	181.87
1908	183.31	160.58	185.23
1909	139.00	147.70	172.35



DISCUSSION.

The PRESIDENT. There is no one, probably, who can discuss this paper more wisely than the representative of a great New England city, which city has had for a very long period of time an exceptionally good body of vital statistics. I will ask Dr. Chapin, of Providence, to respond.

Dr. CHAPIN. Mr. President, we have had good statistics in Providence for a long time, owing, as you well know, to my predecessor, Dr. Snow, who began his good work in 1856. I want to thank Dr. Davis for the work that he has done in analyzing these figures. It certainly represents an enormous amount of labor, and it will prove a most excellent thing for the education of the popular mind in regard to the value to be placed upon statistics as they are ordinarily published. It is customary throughout this country to give out general death rates as indicating in a very accurate manner the sanitary condition of the community from which they come, but crude death rates are absolutely worthless, as has been amply demonstrated here today. I am sure we can all appreciate the immense amount of labor that has been put into this analysis, and we cannot but feel grateful for the effort which has been made to show us in exactly what directions it is necessary to look for flaws in the argument which is based upon crude death rates. I would like very much to have had an opportunity to have studied this paper and to have discussed some of the points in detail. We have heard a great deal about the low death rate of western cities as indicating a healthy population, and oftentimes as indicating an efficient sanitary organization, but I have always been extremely skeptical about these claims. In regard to this particular comparison I have paid some attention in years past to the details of sanitary administration in Chicago and in Boston. There is no need here to say anything about the sanitary administration of Boston. We know that it stands foremost in this country. From what I have seen of the work done in Chicago it did not seem to me that it was equal to that done in Boston, and it has been surprising that men could be found to claim that the low crude death rate in Chicago was due to the sanitary activity of the municipal government of that

city. I am very glad indeed to have had it demonstrated here today that the death rate in Chicago is due to causes which are entirely beyond human control.

Mr. ALEXANDER WILSON. I don't profess to know anything about vital statistics, but I happened to have lived in Chicago for a couple of years and to have had some experience with the Boards of Health of both cities. I think all that Dr. Chapin has said is perfectly true, and I want to express my appreciation to Dr. Davis for explaining the reason of it all. It was a surprise to me to find the death rate in Chicago so low, and to find conditions as bad as they were there, with as little attempt as had evidently been made in the past to correct these conditions. A more efficient health commissioner is in charge now, and they are spending more money on their health department than before; but certainly things were in a pretty deplorable state until the present administration in Chicago. There is nothing in the health administration of that city that will account for the low death rate that the tables indicate. Their accuracy has been questioned, of course, but the local medical society a few years ago gave them a clean bill of health. They believe that their vital statistics are correct today.

CONDENSED MILK AND ITS VALUE FOR GENERAL USE AND FOR INFANT FEEDING.

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The use of this type of milk has become so extensive as to warrant an investigation of the quality of some of the brands upon the market. The demand for condensed milk appears to be constantly increasing, and received a great impetus in 1907, when the price of whole milk was advanced throughout the city. This inquiry was commenced with a view of gaining an insight into the quality of some of these products, in order to determine whether or not their employment as substitutes for milk and cream is founded on economic principles, and also to ascertain if they are suitable for infant feeding. The claims made upon the labels of many of these specimens form an ample basis for study as to their value, when diluted with water according to directions, for subsequent use by both adults and the young. This research did not include all of the brands upon the market, but was confined to those which seemed to fairly represent the two types of condensed milk, namely, the sweetened and unsweetened varieties. The names of the brands examined, together with other information and the results of the analyses* are given in the following table:

*METHODS—The methods used in the chemical examination of the sweetened condensed milks were those given in the U. S. Dept. Agriculture, Bureau Chemistry Bulletin 107, pp. 122 and 123, except that in the determination of protein by the Gunning method the factor 6.38 was used instead of 6.25.

In the chemical examination of unsweetened evaporated milks, the following methods were used: Total solids, Bulletin 107, p. 123; Ash, Bulletin 107, p. 123; Milk Sugar, Optical Method; Proteids, by difference. Fat, a special modification of the Babcock Method, as follows:

Weigh 6.00 grams thoroughly mixed exaporated milk into a ten per cent Babcock Test Bottle. Add ten cubic centimeters of water, and mix thoroughly. Add 17.5 cubic centimeters sulphuric acid (s. g. 1.81) and, after mixing by rotation in the usual manner until all curd is apparently dissolved, place the bottle with contents in boiling water for twenty minutes. Finally, place test bottle with contents in centrifugal machine and finish as in regular Babcock Method.

TABLE A.

Brand	I. Analyses of Condensed Milk.											II. Degree of Condensation, Calculations Based On.					III. Calculated Fat in Original Milk					
	Price per Can, Cents	Wt. of Contents of Can, Gms.	Water	Total Solids	Cane Sugar	Milk Solids	Ash	Protein (Nx6.38)	Milk Sugar	Fat	Fat in 12.15 Milk Slds.	0.64% Ash	8.5% Solids Not Fat	8.9% Solids Not Fat	9.3% Solids Not Fat	Average	0.64% Ash	8.5% Solids Not Fat	8.9% Solids Not Fat	9.3% Solids Not Fat	Average	Ratio of Protein to Fat
Challenge	11	372	29.30	70.70	37.11	33.59	1.50	7.88	15.66	8.55	3.09	3.73	4.68	4.48	4.28	4.24	3.64	2.90	3.03	3.17	3.20	0.92
Green Mountain	11	372	23.80	76.20	41.47	34.73	1.90	9.29	14.84	8.70	3.04	5.07	5.23	4.99	4.77	5.00	2.93	2.84	2.97	3.11	2.97	1.07
Summit	10	372	28.60	71.40	41.00	30.40	1.85	8.88	11.72	7.95	3.18	4.90	4.47	4.27	4.08	4.42	2.75	3.03	3.17	3.30	3.05	1.12
Cupid	10	337	24.10	75.90	45.32	30.58	1.54	8.55	14.04	6.45	2.56	4.40	5.19	4.96	4.75	4.82	2.69	2.27	2.38	2.48	2.45	1.32
Standard	11	403	25.80	74.20	41.63	32.57	1.75	8.37	13.60	8.85	3.30	4.69	4.78	4.57	4.37	4.60	3.23	3.17	3.32	3.47	3.30	0.95
Rose	12	410	27.65	72.35	38.76	33.59	1.58	7.83	15.18	9.00	3.27	4.04	4.73	4.52	4.32	4.40	3.64	3.11	3.26	3.41	3.34	0.87
Tip Top	12	412	27.20	72.80	38.78	34.02	1.40	8.18	15.44	9.00	3.22	3.58	4.81	4.59	4.39	4.34	4.11	3.06	3.20	3.35	3.39	0.91
Defiance	10	372	23.40	76.60	45.87	30.73	1.50	7.90	13.38	7.95	3.15	4.34	4.94	4.73	4.52	4.63	3.38	2.97	3.11	3.26	3.17	0.99
Eclipse	12	424	24.90	75.10	44.01	31.09	1.51	8.24	13.54	7.80	3.05	4.22	4.89	4.68	4.48	4.57	3.31	2.85	2.97	3.11	3.05	1.06
Red Cross	11	410	24.25	75.75	43.01	32.74	1.51	8.73	14.10	8.40	3.12	4.15	5.02	4.79	4.58	4.63	3.55	2.94	3.08	3.22	3.18	1.04
St. Charles*	10	338	70.15	29.85	.....	29.85	1.40	8.80	10.95	8.70	3.55	2.19	2.49	2.37	2.27	2.33	3.97	3.49	3.67	3.83	3.74	1.01
Van Camp*	10	447	73.05	26.95	.....	26.95	1.50	8.30	9.80	7.35	3.32	2.34	2.31	2.21	2.11	2.25	3.14	3.18	3.33	3.48	3.27	1.13
Carnation*	5	180	75.60	24.40	.....	24.40	1.15	7.95	8.10	7.20	3.58	1.80	2.02	1.93	1.85	1.90	4.00	3.56	3.73	3.89	3.79	1.10
Carnation*	10	450	73.65	26.35	.....	26.35	1.25	7.90	9.10	8.10	3.75	1.96	2.15	2.05	1.96	2.03	4.13	3.77	3.95	4.13	3.99	0.98
Highland*	10	333	71.10	28.90	.....	28.90	1.30	9.00	9.60	9.00	3.79	2.03	2.34	2.24	2.14	2.19	4.43	3.85	4.02	4.21	4.11	1.00

By difference

* Unsweetened condensed milk.

While these findings may be considered from various points of view, the fat content of condensed milk is of chief importance from the manufacturer's standpoint, for the reason that the commercial value of milk is calculated on a fat basis. Under these circumstances the use of low grade milk, i. e., containing a small amount of fat, or a milk from which a portion of the fat has been removed (for cream or butter), will yield the manufacturer a higher profit than though a normal milk was employed. Thus the quality of milk used in these products is of interest to the consumer, and likely to be of financial advantage to the manufacturer. Unfortunately there is no method by which the exact amount of fat in the original milk may be determined. It is true, however, that calculations may be and are often employed to establish the quantity of fat in the milk before condensation, but at the best the results so obtained are only approximate. They are largely based upon the assumption that arbitrary factors, (as those for milk solids, solids not fat, or ash), selected for calculation purposes, represent the original milk. By employing for such data, however, average factors, close resemblance to the fat content may be attained. The calculations in the above table were to ascertain the degree of concentration and amount of fat in the milk used by the manufacturer. While the results obtained by use of the various factors are of interest, the averages are of chief importance, particularly in the closeness with which the average percentage of calculated fat agrees with the result obtained when 12.15 (the legal percentage of milk solids in Massachusetts) is used in determining this fat value. It is believed that the figures from this latter method, and the averages above mentioned, represent nearly the quality of milk which entered into these products.

It will be observed that there is considerable variation in the percentage of fat in the condensed milk, as shown in Table A. In the sweetened samples the minimum amount is 6.45 per cent, and the maximum 9.00 per cent, a difference of 2.55 per cent. In the unsweetened the difference is less, being 1.80 per cent, the minimum quantity being 7.20 per cent. and the maximum 9.00 per cent. Thus this product is extremely variable as to composition, not only as between different brands, but specimens of the same brand are not constant as to fat content; a difference of 0.9

per cent of fat having been found in two samples of one make. These differences are further emphasized by the work of other investigators.

While it is not possible, as previously indicated, to determine the exact amount of fat in the original milk from which condensed milk is prepared, approximations show that in the preparation of some of the above specimens, either milk of abnormally low grade was used, or milk was employed from which a portion of the cream had first been removed. In any event it is significant that very few of the samples shown in the above table indicate that milk of high grade was employed in their manufacture.

Despite the fact that the exact composition of the milk prior to condensation cannot be ascertained, it is feasible to estimate the value of condensed milk when diluted with water for use by the consumer. This has been accomplished by determining the cost of a quart of standard milk (Massachusetts law) containing 3.35 per cent* of fat, when made from these products by means of the addition of water. The weight, fat content and price of each brand was the data upon which these calculations were based.

The results appear in Table B.

TABLE B.

SHOWING THE COST OF A QUART OF STANDARD MILK CONTAINING 3.35 PER CENT OF FAT, WHEN MADE FROM CONDENSED MILK.

Brand	Cost Per Quart	Brand	Cost Per Quart
Green Mountain	11.1 cents	Van Camp	10 cents
Standard	10.1 "	Summit	11.1 "
Eclipse	11.9 "	Tiptop	10.6 "
Red Cross	10.4 "	Rose	10.6 "
Highland	10.9 "	Challenge	11.4 "
Carnation (5 cent can)	12.6 "	Defiance	11.1 "
" (10 cent can)	9. "	St. Charles	11.2 "
Cupid	15.1 "		

*Much of the commercial milk has a fat content in excess of this amount.

It is plainly apparent from these figures that the use of condensed milk is unwarranted, if motives of economy are to be considered. The cheapest milk when so prepared, namely, that made from the Carnation brand, exceeds the price at which the householder usually purchases milk, nearly equals that of inspected milk, and, the cost in all other instances exceeds the price of inspected milk, and with two brands the expense would be above that of certified milk. It follows then in practically every instance that the product made by diluting condensed milk is the most expensive which the consumer can purchase; furthermore, from another point of view, comparison with inspected and certified milk is still less favorable to diluted condensed milk, for the production of milk for condensing purposes is never attended with the precautions for care and cleanliness which characterizes inspected and certified milk dairies. Inspected and certified milk is also procured from tuberculin tested cows, which cannot be claimed for that used in condensaries.

Condensed milk has a limited legitimate field, for which it was originally intended; namely, that of supplying a product where fresh milk is not available. Other than this its use is attended with unnecessary and unwarranted expense to the purchaser. The energy involved in the preparation of condensed milk, the tin cans used for containers, the marketing and advertising are factors tending to make the diluted milk expensive, and for all of these items the consumer pays. Small wonder that the cost of a quart of such milk is large. Where fresh milk can be obtained, the employment of condensed milk as a substitute is a luxury.

All of the samples examined bore labels upon which appeared directions for diluting the contents. It was deemed of interest to ascertain the character of the product which resulted when these directions were followed. This data was calculated from the original analyses. For comparative purposes it should be borne in mind that the standard for milk in this state is not less than 12.15 per cent of milk solids and not less than 3.35 per cent of fat. The results follow:

TABLE C.—Composition of Mixtures of Condensed Milk and Water Prepared as Directed for Ordinary Use

Brand	Proportion of Milk to Water	Water %	Milk Solids %	Fat %	Milk Sugar %	Cane Sugar %	Proteids %	Ash %
SWEETENED								
Summit	1 to 4	85.72	6.09	1.59	2.35	8.19	1.78	0.37
"	1 to 3	82.14	7.61	1.99	2.93	10.25	2.22	0.47
Tip Top	1 to 4	85.43	6.81	1.80	3.09	7.76	1.64	0.28
"	1 to 3	81.79	8.51	2.25	3.86	9.70	2.05	0.35
Rose	1 to 4	85.51	6.73	1.80	3.04	7.76	1.57	0.32
"	1 to 3	81.90	8.40	2.25	3.80	9.70	1.96	0.39
Challenge	1 to 4	85.85	6.72	1.71	3.13	7.43	1.58	0.30
"	1 to 3	82.30	8.41	2.14	3.92	9.29	1.97	0.38
Defiance	1 to 4	84.66	6.15	1.59	2.68	9.19	1.58	0.30
"	1 to 3	80.81	7.70	1.99	3.35	11.49	1.98	0.38
Green Mountain	1 to 4	84.76	6.95	1.74	2.97	8.29	1.86	0.38
" "	1 to 3	80.96	8.68	2.17	3.71	10.36	2.32	0.48
Standard	1 to 3	81.48	8.14	2.21	3.40	10.38	2.09	0.44
Eclipse	1 to 4	84.96	6.22	1.56	2.71	8.82	1.65	0.30
"	1 to 3	81.22	7.78	1.95	3.39	11.00	2.06	0.38
Red Cross (a)	1 to 1 *	62.13	16.37	4.20	7.05	21.50	4.37	0.75
"	1 to 4	84.83	6.55	1.68	2.82	8.62	1.75	0.30
Cupid	1 to 4	84.80	6.12	1.29	2.81	9.08	1.71	0.31
"	1 to 3	81.01	7.65	1.61	3.51	11.34	2.14	0.39
UNSWEETENED								
Carnation (5 cent can)	1 to 2	91.87	8.13	2.40	2.70	None	2.65	0.38
" (10 cent can)	1 to 2	91.21	8.79	2.70	3.03	"	2.64	0.42
St. Charles (b)	1 to 1 †	85.06	14.94	4.36	5.48	"	4.40	0.70
" "	1 to 2 †	90.05	9.95	2.90	3.65	"	2.93	0.47
" "	1 to 3 ‡	92.53	7.47	2.18	2.74	"	2.20	0.35
Van Camp (c)	1 to 1	86.53	13.47	3.67	4.90	"	4.15	0.75
" "	1 to 2	91.03	8.97	2.45	3.26	"	2.76	0.50

* "Cream." † "Rich milk." ‡ "Economical milk."

(a) 20.6 fluid ounces of this mixture would cost 11 cents.
(b) 22.4 " " " " " 10 cents.
(c) 29.6 " " " " " 10 cents.

It will be observed from the above figures that the product of these dilutions in all but three instances is of extremely poor quality, and not suitable to be characterized or used as milk. Those who prepare milk on the above basis are practising self-deception. Each consumer who follows these labelled directions thus becomes a milk adulterator, and is using water with a degree of liberality which would astonish the most brazen of former old-time milk manipulators. With three exceptions, the value of these diluted products depends principally upon bulk; quality is a minor consideration. They are mostly rich in water, but in little of other milk constituents. More economy would follow and there would be no sacrifice of quality (eliminating the above exceptions), if to a quart of fresh milk one-third to more than one quart of water was added. Products would result in nearly every instance which would equal the extremes of those which appear in the above table. In the case of the three exceptions previously mentioned, where the products are diluted with an equal part of water, mixtures result containing more than the legal amount of fat but their cost, considering the resulting volumes, would by comparison with the price of an equal bulk of milk be prohibitive. Sweetened condensed milk may be diluted to a greater extent than the unsweetened, without the difference in thinness becoming manifest, by reason of the "body" given the sweetened product by the added sugar.

It is largely upon the fraud basis, namely, the supposition that condensed milk could be diluted freely with water, and that the resulting mixtures possessed the approximate qualities of normal milk, that manufacturers of condensed milk have secured the present enormous and profitable business. The public has been deceived, and for this the manufacturers are responsible. The directions on the labels of some of these brands are general, while with others they are specific. One, the "Peerless,"* directs dilution with water to the required consistency for "purposes where ordinary milk or cream would be used." The sample of the condensed product examined contained only 8.00 per cent of fat, while the legal fat standard of cream in Massachusetts is 15 per cent. Even without dilution the Peerless

* The analysis of this brand does not appear in Table A.

brand would not be legal cream in this state. The label on the St. Charles brand states that the product has been "reduced to the consistency of cream." It contained only 8.70 per cent of fat, and the "rich milk" made by diluting this product according to directions would have contained fat as follows:

(1 of milk to 1 of water) = 3.98 per cent of fat; (1 of milk to 2 of water) = 2.65 per cent of fat, while the "economical milk" (1 of milk to 3 of water) = 1.99 per cent of fat.

The label of the Highland brand states that for certain uses "it may be slightly diluted with water, and for other purposes it may be further diluted to any desired consistence." The original contained 9.00 per cent of fat.

The label on the Red Cross brand states that "mixed with an equal quantity of water, an excellent quality of cream is produced." A mixture so made would contain only 4.50 per cent of fat. The "rich milk" of this brand, prepared according to directions, would contain only 2.59 per cent of fat. Dilute "according to personal taste" with "one or two parts of water" is the recommendation on the label of the Van Camp brand. These mixtures would have contained fat respectively as follows:

(1 of milk and 1 of water) = 3.67 per cent of fat. (1 of milk and 2 of water) = 2.45 per cent of fat.

Thus statements not always characterized by truth find a conspicuous place upon the labels of many brands of condensed milk, and these claims are apparently valuable assets to the condensed milk business.

The most important feature of these preparations in their bearing upon the human economy is that of their employment for infant feeding. Directions for making dilutions for this purpose appear upon the labels of many brands. The fallacy of their use as nourishment for infants is shown in the following table, which indicates the proportion of the constituents of the different mixtures, when made according to the printed formulae. These percentages are calculated from the analyses of the undiluted milk, like those in the preceding table.

TABLE D.—Composition of Infant Foods When Prepared as Directed.

Brand	Age of Infant	Proportion of Milk to Water	Water %	Milk Solids %	Fat %	Milk Sugar %	Cane Sugar %	Proteids %	Ash %
Highland*	1 week	1 to 16†	98.29	1.71	0.53	0.57	None	0.53	0.077
" *	10–12 months	10 to 36†	93.76	6.24	1.96	2.07	"	1.93	0.28
St. Charles*	1 month	1 to 7	96.26	3.74	1.09	1.37	"	1.10	0.18
" " *	2 months	1 to 6	95.74	4.26	1.24	1.56	"	1.26	0.20
" " *	1 year	1 to 3	92.54	7.46	2.17	2.74	"	2.20	0.35
Red Cross	1 month	1 to 13	94.60	2.33	0.60	1.01	3.07	0.62	0.10
" "	2 months	1 to 11	93.69	2.73	0.70	1.18	3.58	0.73	0.12
" "	3 months	1 to 10	93.12	2.97	0.76	1.28	3.91	0.79	0.14
" "	6 months	1 to 9	92.43	3.27	0.84	1.41	4.30	0.87	0.15
" "	1 year	1 to 6	89.17	4.68	1.20	2.02	6.15	1.25	0.21
Green Mountain	Use according to age andstrength of child	1 to 14	94.91	2.32	0.58	0.99	2.77	0.62	0.13
" "	" "	1 to 8	91.53	3.86	0.97	1.65	4.61	1.03	0.21
Summit	" "	1 to 14	95.24	2.02	0.53	0.78	2.74	0.59	0.12
"	" "	1 to 8	92.06	3.38	0.88	1.30	4.56	0.99	0.21
Standard	New-born	1 to 16	95.64	1.91	0.52	0.80	2.45	0.49	0.10
"	"	1 to 14	95.05	2.18	0.59	0.91	2.77	0.56	0.12
Carnation (5 cent can)*	Reduce according to age	1 to 6	96.51	3.49	1.03	1.16	None	1.14	0.16
" " " *	" "	1 to 4	95.12	4.88	1.44	1.62	"	1.59	0.23
" (10 cent can)*	" "	1 to 6	96.23	3.77	1.16	1.30	"	1.13	0.18
" " " *	" "	1 to 4	94.73	5.27	1.62	1.82	"	1.58	0.25
Cupid	Use according to age and strength of child.	1 to 14	94.94	2.04	0.43	0.94	3.02	0.57	0.10
"		1 to 8	91.57	3.40	0.72	1.56	5.03	0.95	0.17

* Unsweetened. † The addition of cane sugar is suggested by the printed directions.

Some of the brands make no claim of adaptability for infant feeding and are omitted from this classification, while others seek to foster the use of this substance. One, the Red Cross, under the caption "Important to Mothers" asserts that "Red Cross is prepared especially for Infants. The most perfect substitute for mother's milk. Feed it to your babies and you will use no other. It possesses special nutritive qualities as a food for children." The composition of these mixtures, as shown in the above table, presents a condition both condemnable and criminal. The manufacturers of condensed milk could not have advocated, even though it be by implication, their employment so diluted, without being aware of the small amount of food value which they represented. Such a degree of culpability warrants the severest censure. The profit resulting from the sale of condensed milk for infant feeding, on the basis of these labelled directions, is iniquitous. Not one of these mixtures, even the most concentrated, represents the composition of normal milk during any period following child birth. They rather imitate starvation diet. The employment of milk for an infant not a week old, containing 0.53 per cent of fat, 0.57 per cent of milk sugar, 0.53 per cent of proteids and 0.077 per cent of ash, when human milk four to six days after child birth* contains 2.97 per cent of fat, 6.47 per cent of milk sugar, 2.25 per cent of proteids, and 0.30 per cent of ash, is likely to be attended with disastrous results. This single example is sufficient to show the fallacy of these printed statements. There is the further disadvantage of the presence of cane sugar in these sweetened condensed milks, and in the formulae of some of the unsweetened products the addition of cane sugar is recommended. This is important, in view of the fact that many physicians are of the opinion that this substance is to be avoided in infant feeding. Assuredly its employment should not be suggested by a manufacturer, even though it is essential to the financial success of his product.

There is another aspect of this condensed milk question not lacking in interest, namely, that of bacterial content. Undoubtedly this substance is supposed by laymen to be free from bacteria, and the printed matter upon some of the packages is not

*Carter & Richmond. Dairy Chemistry, by Henry Droop Richmond, p. 324.

such as to disabuse the minds of consumers upon this point. The fact is that while a few of the brands were found to be sterile, with the majority there is no uniformity respecting bacterial content, and while one or more samples of a brand may be sterile, other packages of the same brand may contain large numbers of organisms. This condition was demonstrated by the examinations which were made. The brands found to contain bacteria appear in Table E together with the maximum counts obtained.

TABLE E.

*Bacteriologic Examination of Condensed Milk.

Brand	Bacteria Per Cubic Centimeter	Brand	Bacteria Per Cubic Centimeter
Tip Top	200,000	Green Mountain	570,000
Defiance	520,000	Red Cross	560,000
Cupid	2,000	Challenge	10,000,000
Standard	900	Eclipse	280,000
Summit	17,500	Rose	850,000

* These examinations were made in the Bacteriological Laboratory of the Boston Board of Health through the courtesy of the Director, Dr. Francis H. Slack.

SUMMARY.

First. Condensed milk is seldom prepared from milk rich in fat. Analyses of several of the samples indicate that in a majority of the brands the original milk used was either of low grade in respect to percentage of fat, or that the milk had been skimmed.

Second. The present extensive employment of condensed milk is mainly due to the fact that consumers believe these products can be largely diluted with water, and yield a mixture which closely approximates the composition of milk. This opinion is fostered by the printed matter which appears upon the labels of the different brands. By following the definite and indefinite directions for water dilutions, mixtures impoverished in all milk constituents other than water are obtained, and the

latter is present in excessive amounts, with the exception of the three brands before mentioned, and then only when dilution is with an equal bulk of water.

Third. If condensed milk is diluted with only enough water to make a quart of Massachusetts standard milk, i. e., containing 3.35 per cent of fat, the cost of the latter exceeds the price of ordinary milk, and in some instances equals the price of inspected milk, and in others is more than that of some brands of certified milk. It follows that condensed milk cannot be employed economically where whole milk is procurable.

Fourth. Condensed milk is recommended by implication as a food for infants by those who manufacture it, and directions for dilution for this purpose appear upon the labels of most brands. Mixtures made according to the formulae suggested would be deficient in practically every instance in percentage of milk constituents, as compared with human milk. Furthermore, they either contain or the printed directions suggest the addition of cane sugar, which substance is deemed an objectionable ingredient of infant foods by many physicians. The employment of condensed milk for this purpose is no doubt often at the expense of infant life, and is to be vigorously condemned. The labels on these packages should bear a warning against the use of the contents as food for babies.

Fifth. The impression that most condensed milk is free from bacteria is not founded on fact.

Sixth. There is no justification in the use of misleading statements by the manufacturers of these substances. This should be prohibited by law.

Seventh. Packages of condensed milk should bear a formula for diluting with water, so that the resulting product shall not be below the standard for milk solids and fat of any state in which the original product may be sold. Legislation to this end should be sought in every State in the Union.

DISCUSSION.

Dr. FRANCIS H. SLACK. Professor Jordan's paper has thrown a flood of light on this subject, and such information should be widespread, in order that people may not be deceived by the labels that go out upon this kind of milk. We have long been finding fault with impure milk and condemning it because of its share in producing high infant mortality and morbidity. If we can condemn our market milk for that I think we can more justly condemn condensed milk, which not only may be high in bacterial content, but, as has been shown here, is often very low in nutritive values. It would be very interesting to know the dairy conditions where such milk is produced. Here in Boston we examine milk continually, making bacteriological and chemical examinations, in order to keep it up to the standard. Our contractors are using every effort to keep the dairies in sanitary condition as a result of these examinations, and still with all that is going on it is with the utmost difficulty that we are able to keep some of these dairies even in a passable condition. What must be the condition of dairies where the only examination that is required is one for a percentage of fat when the milk is delivered at the creamery? I suppose that some of these people do try to produce clean milk, but I think we might fairly take as a sample the case of the Borden Condensed Milk Co., who, as it seems to me, have earned the condemnation of all right thinking people by the stand they have taken against pure milk in the fight they are waging against the Montclair, N. J., Board of Health. I have recently heard of an inspection that was made of the dairies of one other firm who make condensed milk. It was said that the dairies were in a most unsanitary condition, and it is legitimate to suppose that such dairies would be in fairly unsanitary condition where no inspection is required. Even if the milk is sterilized in the process of evaporation it would seem that with such dairy conditions as prevail it would be absolutely unfit for infant food, on account of its filthy condition before the process of evaporation.

There is one more point I thought of bringing out here, and that is the uncertainty as to the age of this milk as we buy it in the stores. There is nothing on the label to indicate when

the milk was produced. We buy a can of this milk in the store; it may be one year old or ten years old. If such milk is to be put on the markets there certainly should be some legal restriction. It should be required that it be dated, and after a certain time limit it should be destroyed. Such food must deteriorate in tin cans as much, it seems to me, as other foods we have heard so much about lately, deteriorate in cold storage. I have brought with me here one of the labels which reads:

"Prepared especially for infants. The most perfect substitute for mother's milk. Feed it to your babies and you will use no other." That last sentence, "Feed it to your babies and you will use no other," seems almost like a bit of prophecy. It reminds me of a sign I saw once in a restaurant window which read: "Eat here once, and you will never eat anywhere else."

Mrs. RICHARDS. I have been wondering where the Pure Food Law was that allowed these labels to continue. This case of dilution with 16 parts of water reminds me very much of the label on the old time package of Grape Nuts, which said: "This package contains as much nutriment as ten pounds of beef." I made a remark before a woman's club about that at one time, and immediately heard from the Grape Nuts people. I asked their representative to define what he meant by "nutriment"—if they meant to say that this little package of Grape Nuts had as much fat in it, or if it had as much proteid, or what it was that he called "nutriment." The only thing you could imagine would be that it contained more starch than ten pounds of beef. It does seem to me as though any label like that in regard to diluting condensed milk with water should be capable of criminal prosecution, because it is causing starvation.

As many of you know, we began our study for the children of Boston with the Orange County "evaporated" milk in 1890, because then the milk problem was in bad shape. We could get this milk then which we could sell to the poor mothers at six cents a quart, of as good value as we could get in the stores for that price and much cleaner and safer. We analyzed it, and kept track of it. It came from a carefully inspected establishment. It was evaporated at reduced pressure at 130° F. but not put up in cans. We used that for eight or ten years, and

we saved every baby we put on it. We had in ten years about 100 cases of children that had practically been given up. We had one very interesting case from a physician who sent word to us at the New England Kitchen that he wanted to try this milk on an out of town case. Some was sent, and I discovered later they had not sent any directions for diluting it. That milk was condensed four and a half to one and used undiluted. I expected the baby would die. On the contrary, we found that the baby had thrived from the first teaspoonful and would not take it diluted afterwards.

Dr. N. C. DAVIS. I would like to ask Professor Jordan in this connection a question which with these figures here it might be interesting to have answered. He has calculated in his first chart what the cost of this milk would be as compared with Massachusetts standard milk, 3.35 per cent. fat. It might be interesting to find out whether the cost would be increased over these figures on average Boston milk. That is, is the average standard of milk in the city of Boston above 3.35? If it is, wouldn't that make those figures still higher?

Professor JORDAN. Most certainly it would; but I have taken our standard as a basis for the calculation.

Dr. N. C. DAVIS. About how much higher would that make these figures using the fat content of average Boston milk as a basis for the calculation.

Professor JORDAN. I have no calculations to determine that, but the difference could readily be ascertained.

Mr. HARWOOD. (Barre). I consider this question one of the most important that has been brought before the public for a long time. I, myself, am interested in two phases of this question. One is public health, and the other is the welfare of our dairy interests. As a matter of fact, last year there were something like 6,000,000 less quarts of milk shipped into Boston than was the case in 1906. I have recently had occasion to do a little figuring on this subject. In 1906, in round numbers, there were 114,000,000 quarts of milk shipped into Boston by rail; last year there were 108,000,000. On the basis of the

increase of population—I took as the basis the increase from 1900 to 1905—if that same ratio had continued and the per capita consumption of milk had remained the same as estimated by the Department of Agriculture at Washington, there should have been 10,000,000 more quarts shipped into Boston last year than were shipped in here last year, or 4,000,000 more than were shipped here in 1906. What has taken the place of those 10,000,000 quarts of fluid milk which might have been shipped in here? It is reduced milk in some form or other, either condensed, or evaporated, or concentrated, or powdered milk, or all these together. It is not to be supposed that people have given up the use of milk. The use of this reduced milk has come to amount to something of no mean proportions; but the ignorance on the part of the people which up to now has existed in regard to the quality of condensed milk, it seems to me, is about to be dispelled when we get such a paper as we have heard today from Professor Jordan.

Covering this matter I drew a bill, after consultation with Professor Jordan and some others, and presented that bill to the Legislature, and what was the result? These great manufacturing concerns, one of which I understand is capitalized at $35,000,000, and has, if I remember rightly, 65 different condensories scattered throughout this country from New York to California, together with some other large concerns, came down here to the Legislature, certain activities were started and this bill was simply snowed under. Some of the newspapers came out in the city of Boston and ridiculed the idea of such a bill. Before another year elapses I predict they will have a different view of this matter.

I hope that other organizations will take up this subject and that Professor Jordan and others who are competent to give proper information will be called upon to do so, in order that the public may become awakened and through them the legislators on Beacon Hill. That is the only way we can counteract the influence of great corporations. When the people become educated, then the consumers in this state will be protected, as they should be, by having proper labels upon containers of these reduced milks.

Someone has asked, "Where is the pure food law?" That pure food law, the United States government law which is popularly supposed to protect the people, is used to deceive, in a way, by these very manufacturers, because there is placed nothing further upon the package than that it contains pure milk, and says it is "guaranteed under the pure food and drugs act."

The number of cows in Massachusetts is 32,000 less than it was in 1890, and it has been growing less during the last three years at the rate of 4,500 a year. I contend that it is for the interest of every consumer in this Commonwealth that Massachusetts milk be produced for Massachusetts people and be produced so clean and in such good condition that it will have a name and a reputation for itself. Confidence between the consumer and the producer is the most important thing at this time, outside of this unfair competition. The welfare of the dairymen of this Commonwealth is more important than seems at first thought. Raising the price of fluid milk one cent a quart usually creates a great hue and cry, with the papers at least, and among many consumers, but what does it mean? Take milk at nine cents. People instead of paying that price run over to the grocery store and buy some of this reduced milk which you have heard discussed here today and pay a greater price for it. That, I contend, is foolish for the consumer and unfair to the producer.

We are entering an era of intensive agriculture. The consumers are complaining about high prices. These prices could be lowered if the production of food products was increased. How are we going to increase the fertility of our soil? Fires and improper cropping have removed the humus. You can buy commercial fertilizers and return elements of fertility to the soil, but the humus so necessary in the conservation of moisture and as essential as anything else to the rejuvenation of this soil cannot be put back except as it can be done economically. Green crops, as a rule, cost too much to plow in, and barn-yard manure remains the only profitable means of supplying that humus, in connection, of course, with the fertilizing elements which it contains. Destroy the animal husbandry of this state,

as is being done at the present time through low prices and unfair competition, and you still further destroy the producing power of the soil.

What does this raise of a cent on a quart of milk amount to? It amounts to comparatively nothing in the end, not more than about $1.20 a year per person. That does not seem much, while if measures are taken to build up the animal industry in this state, improve the fertility of the soil, increase the crops and secure a better milk product, the consumer would be one of those most benefited. I contend therefore, that it is in the interest of everybody in this Commonwealth to join with the agricultural interests and by improving the dairy industry bring back the fertility of the soil, and I consider this discussion here today one good move in that direction.

Dr. CHAPIN (Providence). There is one point that has not been emphasized, or at least not very strongly, namely, the danger from condensed milk due to keeping the can open in the house. That subject has been investigated quite a little in England. Sandilands, in London, studying the incidence of summer diarrhoea, found, as others have, that it falls with exceptional severity upon children fed on condensed milk. In that section of London where he worked, the milk that was used was chiefly Nestle's. He investigated the conditions under which it was put up in Switzerland and found that they were almost ideal, that the dairies were in fine condition and the chance of infection of the milk was very small. But when the cans are opened and kept open in the house they can be seen black with flies; they remain that way for two or three days to a week. He believes, as do very many of the leading English health officials, that the chief cause of infantile diarrhoea is infection in the house, and they believe that there is no easier way to get that infection into the child than by the use of condensed milk.

To Professor Jordan we owe a debt of gratitude for this paper. He has worked hard to get the facts, and has presented the facts in a clear manner, and they are facts that everyone of us wants to use every day in our fight against these evil influences. I would like to ask Professor Jordan if he knows anything about

the dried milk which they are using a good deal in England. Some of the health officials there speak very highly of it, and at the municipal milk depot in Sheffield they have been using it in place of the clean milk or the sterilized milk such as we use here. There are also favorable references to it in other English health reports.

Professor JORDAN. In answer to Dr. Chapin, I wish to say that some time ago I investigated a powder made from skimmed milk, which was recommended for bakers use because of its low cost. I found that when used according to directions, a very low grade of skimmed milk resulted, but that if enough of the powder was employed to make a skimmed milk which agreed with the Massachusetts standard, the cost more than equaled that of skimmed milk. Last summer we had occasion to examine one of the powdered milks sold in cans, and I made no calculations as to the cost of the fluid product. A solution could be made from it which approximated the composition of the standard milk of this State; the powder, however, was not free from bacteria.

Prof. M. J. ROSENAU. I am very much surprised to hear that some of these canned milks have such a low nutritive value, and are sold at such a comparatively high price. It was further a matter of surprise to me that sweetened condensed milk is far from being sterile, but contains a large number of bacteria, in certain cases as high as 10,000,000 per cubic centimeter. Such a milk would not be allowed to be sold in accordance with the city regulations were it sold just as milk.

It seemed to me that Professor Jordan in his conclusions has been quite conservative. He might have gone a good deal further, because all of those who have dealings with the children's diseases know that the larger per cent. of rickets and scurvy occur among those babies who have used this class of milk as the chief article of food. There is something about it which predisposes particularly to the nutritional diseases of this class.

The key-note of the whole matter is not a desire to abolish the use or sale of this particular class of milk, for it has a certain place in our dietary, and in our condensed civilization it has

certain uses on account of its keeping qualities; but the whole point is that it should be labeled honestly and sold for just what it is. The statements on the labels, as pointed out in Professor Jordan's paper, at times are so at variance with the facts as to the contents of the cans that these particular brands should come under the purview of the pure food and drug law, since they involve just as much fraud as selling other things mislabeled in many other ways.

These are the chief facts that occur to me, and I thank you very much, Mr. Chairman, for this opportunity to commend and endorse this able and timely paper.

PERSONAL HYGIENE.

By PERCY G. STILES, Ph. D.,
Assistant Professor of Physiology in Simmons College.

WATER DRINKING. This is a subject about which much is written from theoretical standpoints. The familiar teaching has been to the effect that water drinking is to be encouraged and that there is rarely any reason for its restriction unless it be at meal times. The chief services of water in the human system are connected with the carriage of waste products and the promotion of heat discharge through evaporation from the skin and respiratory passages. The requirement of water for urinary secretion is dependent upon the amount of protein and salts in the diet. The requirement for evaporation is conditioned by external temperature and the degree of muscular activity. Thirst can be relied on to prompt one to take sufficient water to meet the latter need. Whether the instinctive practice is the best possible for the kidneys is far more questionable.

It was long ago pointed out by Dreser, a German pharmacologist, that the urine is usually much more concentrated than the blood from which it is derived. The depression of the freezing-point, which is a convenient measure of concentration, is nearly a constant for blood (0.56° C.) while the value for urine is generally twice as great. It may be still more considerable, reaching 4° C. under conditions which force the kidneys to eliminate a maximum of dissolved substances in a minimum volume. To separate from a solution of a lower concentration one which has two or three times as great an osmotic pressure is a task which cannot be accomplished without the expenditure of energy in large and perfectly definite amounts. Dreser calculated that the kidney epithelium may exert a force far in excess of that developed by contracting muscle. If this is the case it is plain that the daily nitrogenous and saline waste must be more easily discharged by the kidneys when enough water is provided to make the urine approximate to the concentration of the blood. A urine less concentrated than the blood is a possibility but one

which is rarely realized. It has been demonstrated after free consumption of beer. The foregoing considerations seem to justify the teaching that most people need to cultivate the habit of water-drinking. Apart from the saving of the kidney epithelium a voluminous urine tends to insure the successful removal of the less soluble constituents such as uric acid. The layman may easily suppose that the work of the kidneys depends upon the amount of water passing through them. As a matter of fact it is apt to be greatest when the volume is least.

The advisability of drinking water without stint at meal times is a special question which must be treated apart from the general one. Several points may be made against it. Marked cooling of the stomach contents must somewhat delay digestion. This cannot be considered a serious matter since harmful fermentation will be postponed in about the same measure as the normal process. The chilling of the stomach walls with consequent retardation of gastric secretion is probably of greater moment. A still more important objection is the temptation to neglect mastication and to substitute swallows of cold water for the saliva which would better be used to soften and wash down the food. The claim that water dilutes the digestive juices so as to lessen their effect is probably groundless. A given quantity of enzyme will act at a nearly constant rate in widely varied volumes of water.

A test of the influence of water with meals upon nutrition has now been made by Dr. P. B. Hawk, of the University of Illinois, and he has presented his results to the American Physiological Society. His subjects were healthy young men. Upon certain days each took but 900 grams of water. Upon other days with about the same solid food they took 3900 grams per man, most of it at meal times. Determinations of the urinary nitrogen showed a slight increase in the output on the days of free water-drinking. This result had been obtained by other observers and had been attributed to a slight increase of protein metabolism or to a more complete elimination of waste. Dr. Hawk took a step beyond his predecessors by determining the fæcal as well as the urinary nitrogen. From his figures it appears that the increase of urinary nitrogen just noted corresponded closely with a reduction of the fæcal nitrogen on the "water days." In other

words, the increased consumption of water led directly to a more nearly perfect absorption of protein. It is true that the fæcal nitrogen on the days of restriction was singularly large (over two grams). It may therefore be claimed that the demonstration is of the bad effects of minimal drinking rather than of the benefits of the freest use of water at meals. This is recognized by Dr. Hawk who promises further experiments with less extreme conditions.

The results already at hand are suggestive. If one avoids the chilling effect of a great deal of cold water and takes pains not to slight mastication there seems to be no reason for denying one's self the water which is craved at the table. The water in tea, coffee, malt liquors, thin soups, and milk of course acts in the same way as water taken separately. Indeed, a factor contributing to the success of Fletcherism may be the extreme dilution of all food with the water of saliva. One of the striking results of this popular practice is the reduction of fæcal nitrogen to a low level and Dr. Hawk's observations suggest a partial parallel. Evidently one must make large allowances for the peculiar properties of different waters, some of which may prove to be constipating while others promote peristalsis. Free drinking of relaxing waters would almost certainly diminish the percentage of absorption.

VETERINARY HYGIENE.

By W. L. BEEBE, D. V. M.,
Bacteriologist for the Minnesota Live Stock Sanitary Board.

STATE AND MUNICIPAL MEAT INSPECTION. During the last few years the subject of state and municipal meat inspection has been much discussed. Few states have ventured to put a law on the statute books requiring inspection, as there are so many difficulties that would prevent an efficient anti-mortem and post mortem inspection in the rural districts, particularly in states that are sparsely settled. If such a law would be impractical there is no reason why one requiring cleanliness and sanitation around slaughter houses would not be feasible. Several states require creamery inspection and it is not an exaggeration to say that the sanitary conditions in slaughter houses where federal inspection does not exist is far worse than it is in creameries. If the people could see the building and surroundings where food producing animals are killed, they would probably rise up in a revolt. It is not likely they will do so until the matter is brought to their attention as Upton Sinclair did when he published "The Jungle."

If anti-mortem and post-mortem inspection is unpractical in the country it is not in cities. The main difficulty in the city seems to be that the slaughter houses are scattered and the proprietors prefer to kill at hours that would prevent one or two inspectors doing the work. Why not adopt the method of segregation of slaughter houses the same as is done in Europe where over 600 slaughter houses belonging to municipalities exist. If this method be adopted modern machinery would save for the butchers an amount which would to a large extent compensate them for the animals condemned. A. M. Farrington,* Assistant Chief of the Bureau of Animal Industry, estimated that during the year 1907, there were 4,972,052 head of cattle, 7,793,133 sheep and 10,316,300 hogs slaughtered in the United States by

* The need of state and municipal meat inspection to supplement Federal Inspection. Report of Bureau of Animal Industry, 1908, pp.183-96.

butchers without government inspection, while there were 7,633,365 cattle, 10,252,076 sheep and 32,885,377 swine slaughtered under government inspection. Among some the conditions mentioned in his article that were found in and around the small slaughter houses are as follows: The slaughter houses are usually located on some back street or outside the corporation limits. Many times they are located on the banks of streams and the drainage is toward the water. Frequently the offal is thrown out to decay or be eaten by hogs and rats, or washed away by the water. Old dairy cows are frequently killed in these houses and from the prevalence of tuberculosis in these cows it follows that the disease will be transmitted to the swine that eat the offal. Hog cholera and certain parasitic diseases are frequently transmitted by this unsanitary method of disposing of offal. The Indiana State Board of Health recently made an investigation of conditions of slaughter houses in the state and out of 327 establishments inspected only 7% were found to fulfill the sanitary standard. Not infrequently in cities where municipal inspection exists the inspectors are laymen not familiar with the diseases of animals.

A very interesting feature of Dr. Farrington's article is the mention of the saving that would be made in the by-products if modern machinery was installed and modern methods adopted. He states that fat cattle dress 60% of the live weight, sheep 50%, and hogs 80%. A large portion of the remainder may be saved in a modern abattoir. Packing house statistics show that in the case of cattle the value of the hide and offal would probably increase the total percentages to 75%. In other words the 40% offal would be equivalent to about 15% of meat. From the facts it would seem as though sanitarians ought to try to have laws passed which would remedy these deplorable conditions.

THE TRANSMISSION OF AVIAN TUBERCULOSIS TO MAMMALS. In the last few years avian tuberculosis has been reported by Pernot in Oregon, Ward and Moore in California, Higgins in Canada, Burnett in New York, the Bureau of Animal Industry in Michigan, and the writer in Minnesota. In several localities the ravages of this disease makes it apparent that it will soon be a more serious menace to the chicken raising industry

than is commonly supposed. Many bacteriologists and scientists are prone to overlook the possibility of transmission of avian tuberculosis to mammals as scientific evidence shows that it is infrequent that such transmission takes place either experimentally or by natural means. It is, therefore, of much interest to report the results of an investigation where it was quite evident that avian tuberculosis was transmitted to swine under natural conditions.

Mohler and Washburn* recently reported such an outbreak which occurred in Oregon. Avian tuberculosis existed on a certain farm and later the pigs were found to be affected, when killed at an abattoir where government inspection is maintained. The history indicated that the tuberculosis in swine did not come from cattle. Several fowls that were tubercular were shipped to the Bureau of Animal Industry, Washington. Two tuberculin-tested pigs two and three months old were fed the tubercular viscera of these fowls. Examinations post-mortem after 104 days revealed lesions of tuberculosis in the submaxillary and mesenteric glands and liver in one pig, and in the submaxillary and mesenteric glands in the other. Cultures were found to conform to the morphological and biological characteristics of the avian tubercle bacillus. During the time these hens were kept at the laboratory two eggs were found in the cage. Guinea pigs were inoculated intra-abdominally from the yolks and whites. The guinea pigs which were inoculated from the white showed tuberculosis upon post mortem examination. From the results of these investigations it would seem that we are now justified in considering tubercular fowls and their eggs dangerous to mammals.

*Report of Bureau of Animal Industry, 1908, pp. 165-176.

ERRATUM:—In February issue, page 197, under Veterinary Hygiene, thirteenth line from bottom, 3d word should read *not* in place of *now*.

SANITARY ENGINEERING NOTES.

By ROBERT SPURR WESTON,
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BRESLAU WATER CALAMITY. Lühring. Gedanken über die Sanierung des Breslauer Grundwassergewinnungsanlagen. Gesund. Ing. **31**, 629–37. Chem. Zentr., 1909, I, 321.

Oettinger, W. Die Ursachen des Einburchs von Eisen und Mangansalzen in das Breslauer Grundwasser, mit besonderer Berucksichtigung der Bodendurchlassigkeit in der Ohle-Oderniederung. Klin. Jahrbuch. **19,** 305–421. Chem. Zentr., 1909, I, 226.

Debusmann. Wasserkalamitöt in Breslau. Chem. Zentr. 1908, II, 7189.

Debusmann. Die Ursachen der Wasserkalamitöt in Breslau und die bisherigen Massnahmen zu ihrer Bereitigung. Jour. f. Gas. u. Wasser. **42,** 963, 990.

All of these articles have to do with the sudden outbreak of manganese in the Breslau water supply, the attempts to explain the reason for the outbreak, and the means for overcoming the difficulty. The contributory parts of the various contributions are admirably summarized in the last reference.

Previous to 1871 the water supply of Breslau was from surface wells. Between 1872 and 1879 an open sand filter was built and in 1891–2 a covered sand filter also having a capacity in 1893 of about 11,600,000 gallons daily. These filters took water from the Oder and their bacteriological efficiency was not always satisfactory. This was because of the rapid increase of population in the industrial cities above the city, increased water traffic on the river, and also to the low efficiency of the filters during periods of turbid water. Largely through the influence of Professor Flügge a preliminary study of the ground water supply was made, which resulted before the close of 1904 in a new ground water supply from the Oder valley above the city and the abandonment of the slow sand filters. This supply

which had a capacity of 16,000,000 gallons daily was derived from 313 6-inch wells driven to depths varying from 33 to 40 feet and placed 70 feet apart. The wells were arranged in three lines and part of them were overflowed at extreme high water. The soil of the Oder River water is made up of a layer of humus matter, silt, and clay, under which is a stratum of alluvial sand in various sized grains. Beneath the sand is diluvial clay 100 to 235 feet in thickness, the top of which is from 30 to 55 feet below the surface. The surface layer of loam, peat, and clay is from 7 to 10 feet thick. The ground water level before beginning the daily pumping was from 20 to 40 inches below the surface of the ground. Beginning with January, 1905, ground water exclusively was supplied to Breslau. Up to March 27, 1906, the ground water level had sunk to 25 feet below the surface during pumping. Previous to this date there had been little rain. There was a deferrization plant in connection with the system consisting of a coke aerator and gravel filter of the Piefke type. The aerator is 2 m., the filter 1 m., deep, and there is a small basin between the aerator and filter.

On March 28, 1906, the river rose and overflowed the third line of wells and also part of the second line. Soon the soil air got beneath the flood water and appeared in the wells, so much of it in fact that the air pump could hardly keep the suction main free. At the same time the amount of iron increased to 440 and the manganese to 220 parts per million. For a time the deferrization plant removed the iron successfully but the manganese passed on to the city and made the water useless for domestic purposes. The supply was abandoned, filtered Oder River water was again supplied to the city, and three open filters were built to tide over the emergency. Many explanations were at once offered but even today no one explanation is universally accepted. Some authorities said that the manganese came from below the water bearing strata, being forced upward by the pressure of artesian water through from 100 to 235 feet of clay schist. Others, and among them the majority of geologists, engineers, and chemists agree with Luedecke that the manganese was leached out of the humus-clay stratum by the overflowing river water. This position was hotly contested by the hygienists of the Breslau school, who affirmed that the passage of flood

water into the wells through the overlying clay stratum is a practical impossibility. Debusmann showed that the river water could reach the wells in as short a time as 12 hours when the valley is overflowed. Engineers who have used clay in dams and embankments do not place much faith in the impenetrability of from 7 to 10 feet of alluvial soil. This alluvial soil contained a large percentage of manganese, which Lührig believes was dissolved by ferrous sulphate in combination with free sulphuric acid, produced in turn by the decomposition of ferrous sulphide. As long as the sulphides were not exposed to air they remained unchanged. The lowering of the ground water level brought air in contact with the sulphides, which oxidized to sulphate and free sulphuric acid which dissolved the abundant MnO_2. At the beginning of the calamity the water in the wells was acid to litmus. The acid could act as a solvent largely because the soil is not rich in alkali. The oxidation and solution of the iron and manganese went on for a year and a half, when the sudden overflow caused the appearance of the accumulated iron and manganese in the ground water. Abegg and others thought that diffusion had something to do with the appearance of manganese in the ground water, but D. does not think this explanation adequate, because after a subsequent flood in September, 1906, the amount of iron in the water of the overflowed wells rose suddenly to more than 100 parts per million and the water again became acid to litmus. A measure of the rise in the ground water showed that about 1,325,000,000 gallons of water had seeped into the water bearing layer during this flood. It is not possible to protect the wells against the contamination by iron and manganese during the floods, and several methods of removal were proposed. Lührig and Blasky advised the treatment of the water after deferrization, first with lime followed by aeration, sedimentation, filtration, and finally treatment with carbon dioxide—practically a softening process. Lührig has also recommended the use of artificial zeolite. These processes, however, have not been adopted. Many of the old wells are unaffected by floods and are in use at the present time. New wells have been sunk and a new intake has been installed about two miles above the city. This intake delivers water to the old filters and can be arranged to deliver it to irrigation fields in

which wells have been sunk. Furthermore, the ground in the vicinity of some of the wells has been irrigated with good results and these experiments are being continued. The tendency, however, is to return again to the Oder and purify the water more thoroughly. During the controversy it was affirmed that the manganese might have come from the diluvium, but an investigation by the Prussian Geological Survey into the composition of the soil and water comprising this layer disproved this statement. At present the mixed filtered and ground water contains from 30 to 40 bacteria per cubic centimeter and is satisfactory in every respect.

Klut, H., Dr., "Nachweiss und Bestimmung von Mangan in Trinkwasser." Mit. K. Prnfgs—Anst f. Wasserversorg u. Abwasserbeseit 12, 182–194.

Author mentions most all known methods for the determination of Mn. For the qualitative determination the process of Vohlhard is recommended. To 25 c. c. of the freshly collected water add 10 c. c. of 25% HCl and heat to boiling. Then add 0.5 g. PbO_2 and boil for from 2 to 5 minutes longer. A red color in the liquid after subsidence indicates Mn. The reaction will detect as little as 0.05 mg. per L.

For quantitative work the author recommends the colorimetric method of Vohlhard and Treadwell. Concentrate 200 c. c. of water and 10 c. c. of 25% HCl to 50 c. c. Add 0.5 g. PbO_2 to the hot solution and boil 5 minutes longer. Then filter through a Gooch crucible into a Hehner cylinder and compare the color with that produced by dilutions of a std. solution of $KMnO_4$. For ordinary purposes this method is exact enough but where chlorine and organic matter interfere the water should be evaporated with H_2SO_4, smoked off and ignited. The dissolved residue should be handled as above. Because permanganic acid is decomposed quite rapidly by dust or organic matter, the comparisons should be made with all possible speed.

Where large amounts of Mn were present (over 10 mg. per L.) the Knorrs Persulphate method was proved the best. Evaporate from 5 to 10 liters of water and 5 to 10 c. c. H_2SO_4. Ignite the residue with a very little $KHSO_4$ to destroy organic matter and then dissolve it in hot water. Then boil the solution for 20 minutes in a 200 c. c. Erlenmeyer flask with 5 c. c. dilute

H_2SO_4 (1:3) and 10 c. c. $(NH_4)_2S_2O_8$ solution (60 g. per L.). After cooling, dissolve the MnO_2 in H_2O_2 solution and titrate back with $\frac{n}{10}$ $KMnO_4$. The H_2O_2 solution is standardized against the $KMnO_4$ solution so that 1 c. c. is equivalent to 2.754 mg. Mn.

WATER SUPPLY AND WATER FILTRATION. Anon. Engineering **89,** 173. An abstract of two papers, "Notes on the Sheffield Water Supply and Statistics Relating thereto," by L. S. M. Marsh, and "Statistical and Experimental Data on Filtration," by W. R. Baldwin-Wiseman.

The first paper takes up variation in supply, discharge, loss of head in pipes, fire streams, water hammer, rainfall, evaporation and run-off of the Redmires Catchment Area and the prevention of the action of water upon lead.

The second paper takes up conservation, self-purification, artificial purification, etc. Loss of head of water in passing through sand with formula. Review of modern methods of water purification.

WHAT CONSTITUTES A BAD WATER. Adolph Gehrmann. First Annual Report of the Lake Michigan Water Commission, 1909 (69–72). A classification of the views that have been expressed on the amount of constituents and bacteria that can be present in water and still make it a safe portable water.

THE TREATMENT OF WATER ANTECEDENT TO FILTRATION. Balfour Bramwell. Engineering, **89,** 185. In a letter the writer questions a statement made in an article on the above, that no impurities pass into the sand of a slow sand filter but are all retained in a filtering film on the surface. A few questions are put forth as an argument for the adoption of chemical treatment, coagulation and mechanical filters rather than the slow sand filtration.

AN EXPERIMENT IN CHEMICAL PURIFICATION OF WATER. Adolph Gerhmann. First Report of the Lake Michigan Water Comm. 1909 (120–123). The treatment of a dilute sewage from Bubbly Creek in the Chicago Stock Yards. First passed through a mechanical filter plant and the effluent, which was not in a stable condition, treated with hypochlorite of lime in amounts varying from 2.0 to 0.4 grains per gallon or 12 to 2

parts available chlorine per million. After treatment the effluent found to have a very low bacterial content with B. coli eliminated and the keeping quality of the water satisfactory.

Chemical content of the water in passing through the plant, with the exception of color, Alb. NH_3, and suspended solids, not greatly reduced. In 45 samples the bacterial content ranged from 125,000 to 3,840,000 per c. c. in the raw water with B. coli present in every sample. In the treated effluent the number with the exception of the first sample did not exceed 38 per c. c. and in some cases dropped to 1 per c.c. B. coli was found in only two samples of the 45. Examination of the city supply carried on simultaneously showed counts varying from 55 to 1376 per c. c. with B. coli present in **43** of the 45 samples.

WATER SUPPLY AND CONDITIONS OF LAKE MICHIGAN FROM THE CALUMET RIVER TO HOWARD AVENUE, CHICAGO. J. F. Biehn. First Annual Report of the Lake Michigan Water Comm. 1909, (109–119). The investigations show a gradual diminution in the degree of pollution as the distance into the lake increases, the degree of pollution being determined by bacterial counts on agar and the presence of the typical B. coli.

As many as 66,000 bacteria per c. c. were obtained south of the Calumet River while four miles out a count as low as 8 per c. c. was obtained. No B. coli were found in samples collected four miles out, some were found in part of the samples taken three miles out, also in some of the samples collected at each place two miles out and in practically all samples collected within the one mile limit.

From the results two zones of pollution were established, a zone of constant pollution within which B. coli were found in all samples. This zone extended out somewhat over a mile on the average, being much wider off the dumping ground and off the Calumet region where large amounts of sewage and manufacturing wastes are thrown into the lake.

A zone of occasional pollution extending about a mile beyond the constant zone.

Beyond the four mile limit apparently no pollution exists.

The Carter H. Harrison and the two mile cribs are surrounded by a zone in which B. coli are found in 60% of the samples.

The pollution of the lake between the limits named appears to come from four sources, the Indiana cities, the southern end of Chicago and the Calumet region, the shipping and the cities on the north shore. The author believes that the accumulation of sewage sediment during the past years tends to keep up the pollution along the north shore.

Results of examinations of water from the various pumping stations show B. coli present in a large percentage of samples varying from 76% in water from cribs within the two-mile limit to 48% in water from the four-mile crib, the average being 73%. The quantitative count on agar showed an average number varying from 116 in water from the Lake View crib to 70 from the four-mile crib, the mean of all being 94.7 per c. c.

The number of bacteria found in the cribs were found to be 500% greater than in the water outside, while the number in the water at the pumping station were less than outside the crib. This extraordinary increase in the crib was due to dead fish, large numbers of which were being constantly removed. The decrease at the pumping station was due to passage through the tunnels. It was found that the difference in the number of bacteria at two pumping stations each taking their supply from the same source was between 50% and 70%, the lower number being found at the inland station, the tunnel to this station was two miles longer than to the other. Examination also showed a reduction of 35% in two miles of mains.

Examination of the Chicago River at the most polluted point showed B. coli in all samples and agar counts varying from 46,000 to 8,000,000 per c. c. while at the mouth the count dropped to 280 to 3000 per c. c.

Examination of the Calumet River and its branches gave counts as high as 8,000,000 per c. c. with B. coli present in all samples.

THE CHARACTER OF THE WATER SUPPLY OF MICHIGAN CITY, IND. H. E. Barnard & J. H. Brewster. First Annual Report of the Lake Michigan Water Comm. 1909. (136–189).

Lake Michigan Water except where polluted is a clear, colorless water with very little organic matter. The only currents affecting the intakes of the Michigan City supply are those

caused by winds. At times these currents are into the harbor and creek which receive all of the sewage of the city and at these times no harbor water finds its way into the Lake. At times of freshet or off shore winds there may be a strong current out of the harbor causing a discharge into the lake of all the stored up filth.

The causes of pollution of the southern end of the lake are:

Discharge of harbor water into the lake.
Shore wash.
Dumping of dredged material.
Shipping.
Disturbance caused by sand dredges.

To offset this pollution are:

Dilution.
Sedimentation.
Lack of organic matter necessary for bacteria growth.
Sterilizing action of sunlight.

The city received its supply from the lake but occasionally during the winter when the intake becomes clogged with ice the supply is taken direct from the harbor. The harbor acts as a huge settling basin.

Analyses of the water at the harbor intake of the water supply and at the mouth of the harbor show a reduction in total solids of 260 to 138, volatile solids 80 to 16, free NH_3 0.280 to 0.016, nitrites 0.060 to 0.002 and chlorine 15 to 4 parts per million. The bacterial examination shows a decrease from 52,500 per c. c. at the Fourth St. sewer to 40 per c. c. at the east end of the breakwater.

The investigation showed that the lake intakes gave a safe wholesome supply but the occasional use of the sewage ladened harbor water and the use of wells of which nearly 50% of those examined were found polluted, were the cause of the high typhoid, the high rate in the winter and spring being directly caused by the use of harbor water.

The tables and charts giving the results of chemical and bacterial examinations show the movement of the sewage in the harbor and lake and the condition of the lake surrounding the intakes.

PUBLIC HEALTH LEGISLATION, NEWS AND NOTES.

By FRANCIS H. SLACK, M. D.,
Director, Boston Board of Health Laboratory.

A NATIONAL DEPARTMENT OF PUBLIC HEALTH.

(S. 6049, Sixty-first Congress, second session.)

In the Senate of the United States. February 1, 1910. Mr. Owen introduced the following bill, which was read twice and referred to the Committee on Public Health and National Quarantine:

A bill establishing a department of public health, and for other purposes.

BE IT ENACTED, ETC., That there is hereby established a department of public health under the supervision of the secretary of public health, who shall be appointed by the President a Cabinet officer, by and with the consent of the Senate, at a salary of $12,000 per annum, with like tenure of office of other Cabinet officers.

SEC. 2. That all departments and bureaus belonging to any department, excepting the Department of War and the Department of the Navy, affecting the medical, surgical, biological, or sanitary service, or any questions relative thereto, shall be combined in one department, to be known as the department of public health, particularly including therein the Bureau of Public Health and Marine-Hospital Service, the medical officers of the Revenue-Cutter Service, the medical referee, the assistant medical referee, the surgeons and examiners of the Pension Office; all physicians and medical officers in the service of the Indian Bureau or the Department of the Interior at old soldiers' homes, at the Government Hospital for the Insane, and the Freedman's Hospital and other hospitals of the United States; the Bureau of Entomology, the Bureau of Chemistry and of Animal Industry of the Department of Agriculture; the hospitals of the Immigration Bureau of the Department of Commerce and Labor; the emergency relief in the Government Printing Office, and every other agency of the United States for the protection of the health of the people United States, or of animal life, be, and are hereby transferred to the department of public health, which shall hereafter exercise exclusive jurisdiction and supervision thereof.

SEC. 3. That the official records, papers, furniture, fixtures, and all matters, all property of any kind or description pertaining to the business of any such bureau, office, department, or branch of the public service is hereby transferred to the department of public health.

SEC. 4. That the secretary of public health shall have supervision over the department of public health, and shall be assisted by an assistant secretary of public health, to be appointed by the President, by and

with the advice and consent of the Senate, at a salary of $6,000 a year, with such duties as shall be prescribed by the secretary not inconsistent with law.

SEC. 5. That the secretary of public health shall be authorized to appoint such subordinates as may be found necessary. There shall be a chief clerk appointed, at a salary not to exceed $3,000 a year, and such other clerks as may from time to time be authorized by Congress.

SEC. 6. That the officers and employees of the public service transferred to the department of public health shall, subject to further action by Congress, receive the salaries and allowances now provided by law.

SEC. 7. That it shall be the duty and province of such department of public health to supervise all matters within the control of the Federal Government relating to the public health and to diseases of animal life.

SEC. 8. That it shall gather data concerning such matters; impose and enforce quarantine regulations; establish chemical, biological, and other standards necessary to the efficient administration of said department; and give due publicity to the same.

SEC. 9. That the secretary of public health shall establish a bureau of biology, a bureau of chemistry, a bureau of veterinary service, a bureau of sanitary engineering, reporting such proposed organizations to Congress for suitable legislation relative thereto.

SEC. 10. That all unexpended appropriations and appropriations made for the ensuing year shall be available on and after July 1, 1910, for the department of public health, where such appropriations have been made to be used by any branch of the public service transferred by this act to the department of public health. It shall be the duty of the secretary of public health to provide, on proper requisition, any medical, sanitary, or other service needed of his department required in another department of the Government.

SEC. 11. That any other department requiring medical, surgical, sanitary, or other similar service shall apply to the secretary of public health therefor wherever it is practicable.

SEC. 12. That all officers or employees of the Government transferred by this act to the department of public health will continue to discharge their present duties under the present organization until July 1, 1910, and after that time until otherwise directed by the secretary of public health or under the operation of law.

SEC. 13. That all laws or parts of laws in conflict with this act are hereby repealed.

The Hon. Robert L. Owen, of Oklahoma, delivered an able and convincing argument in favor of the above bill, March 24, 1910, in the U. S. Senate. Mr. Owen has behind him in this movement the combined strength of the American Public Health Association, The American Medical Association, and all progressive health organizations of the country.

It is difficult for those familiar with the situation to understand the animus for opposition to this desirable legislation, looking as it does for the better health and necessarily better economic condition of the people of these United States.

Senator Gallinger's (N. H.) frequent interruptions and questions during the course of Senator Owen's speech may have been for the purpose of bringing out more clearly and in greater detail the benefits of the proposed department. If so, they served the purpose admirably.

Such a department should work without friction with existing health organizations in the various states and should serve to exalt preventive medicine to that high position it should occupy in a civilized country.

RED PLAGUE SOCIETY OF CALIFORNIA. In April, 1909, there was organized at a meeting of the California Public Health Association, a daughter society appropriately named the "Red Plague" Society of California, since its object is to popularize knowledge concerning those two great scourges, Syphilis and Gonorrhoea, which owe their hold on humanity to the special vices of the so-called "Red Light" districts of our cities. The April, 1910, Bulletin of the California State Board of Health is especially devoted to a discussion of this subject and contains an article by the Executive Officer of the Board, Dr. Wm. F. Snow, urging a nation wide campaign of education and the development of effective legislation to meet the situation.

The system hitherto followed of forbidding teaching concerning these diseases and of considering it evidence of impurity to have knowledge concerning them has been exceedingly fruitful in allowing a wide-spread infection of our population.

Teaching concerning tuberculosis, its causes and prevention, has in recent years been popularized to such an extent that very few are ignorant concerning the essential factors of this disease. As a result people have shown themselves eager to follow proper methods of living as a protection from the dangers of the great white plague. Surely they will not much longer be content to suffer untold miseries from the ravages of this greater plague of venereal diseases now that socities are springing up throughout the country which, like the California society, make it an

object to disseminate the facts concerning these preventable diseases.

For the safety of the public such knowledge should be widespread and these diseases should be reportable. There is too much prudery and hypocrisy along this line. In school our children are taught many subjects of less value than these vital ones concerning their health and well-being. At church they listen to flowery figures of speech and religious platitudes but the right-teaching and true religious service is denied them when we withhold those teachings concerning sexual matters which are necessary, making a mystery of things which should be carefully taught and especially when we neglect to warn them of unseen and terrible foes which, though easily avoidable by those with knowledge, are dragging thousands upon thousands through a miserable existence of disease and shame.

It is significant that the formation of this Californian society is due to the efforts of a woman. It is appropriate that women should take the front and force this battle against foes from which they are the greatest though often innocent sufferers.

The campaign of education concerning venereal diseases has begun. Such a campaign deserves and should receive the support of all informed persons. However profitable in the saving of life and the minimizing of suffering the campaign against the great white plague has been, it would seem that a much greater benefit may be conferred upon humanity by a well directed crusade against the twin evils, syphilis and gonorrhoea.

THE COMMON HOUSEFLY receives the full attention of the Kansas State Board of Health in their monthly bulletin for April, 1910. The Kansans who have already been saved from the dangers of the common drinking cup through the energies of their State Board of Health, are now given timely and complete information concerning this great disease carrier and common nuisance (the musca domestica).

They also publish and recommend for adoption by cities and towns the following ordinance, with credit to the Indiana State Board of Health:

AN ORDINANCE to protect the public health against disease and poisons carried by flies.

WHEREAS, It is commonly known that flies are very dangerous carriers of filth, filth poisons and disease germs, that they are born in filth and are a constant threat against the health, happiness and prosperity of the people; therefore,

SECTION 1. Be it ordained by the mayor and council of the city of ————, that it shall be unlawful for any person, firm or corporation to suffer or permit or have upon their premises, whether owned or leased by them, any one or more of the following unsanitary fly-producing, disease-causing conditions, to-wit: (1) Animal manure in any quantity which is not securely protected from flies; (2) privies, vaults, cesspools, pits or like places, which are not securely protected from flies; (3) garbage in any quantity which is not securely protected from flies; (4) trash, litter, rags or anything whatsoever in which flies may breed or multiply.

SEC. 2. It shall be the duty of the chief of police or city marshal and health officers, upon learning in any way whatsoever of the existence of one or more of the unlawful conditions described in Section 1 of this ordinance, to notify the offender in writing, upon order blanks provided by the city clerk, to remove or abate said unlawful conditions, stating the shortest reasonable time for such removal or abatement. In the event of the refusal or neglect on the part of the notified offender to obey such order, the chief of police or health officer shall inform the street commissioner, upon a blank provided by the city clerk, and it shall then be the duty of said street commissioner, and he shall have power and authority, to remove and abate the reported unlawful conditions; and he shall keep an accurate account of the cost and expenses thereof, which shall be paid from the city treasury upon the sworn vouchers of the street commissioner, and said cost and expenses shall be a lien upon the property and shall be collected by law as taxes are collected and duly paid into the city treasury.

SEC. 3. Any person, firm or corporation found guilty of having created or suffered to exist on premises either owned or leased by them any one or more of the unlawful conditions named in Section 1 of this ordinance shall be punished by a fine of not less than five nor more than fifty dollars.

SEC. 4. All ordinances or parts of ordinances in conflict with this ordinance are hereby repealed; and whereas an emergency exists, this ordinance shall be in effect upon and immediately after passage.

DR. HERBERT D. PEASE AND A. J. PROVOST, JR., have been appointed to succeed Dr. Ernst J. Lederle as sanitary experts for the Board of Water Supply of New York City.

BOOK REVIEWS.

The Origin and Prevalence of Typhoid Fever in the District of Columbia. Bulletin No. 52. Hygienic Laboratory, U. S. P. H. and M. H. S., 1909.

To the epidemiologist this the third bulletin on this subject is a rare treat of facts, figures and logical deduction therefrom as concerns the *prevalence* of the disease. But its *origin* is not accounted for. The authors eliminate all imported cases, and of the remainder regard 20% as secondaries and 10% as milk infections. Eliminating the secondaries because immaterial to the question of origin, 88% of the true native primaries remains a mystery.

No one can do otherwise than most sincerely praise, even with envy, the wealth of detail in the investigation, the care in arrangement of data, the skill in interpretation, even though one remains nonplussed that at the end of the third year of investigation, the problem is still "unsolved."

Let us confess that we were prejudiced against the hypothesis that water was responsible in Washington, that we wanted to believe milk, contact, flies, food, carriers, etc., would prove all sufficient, that we approached the reading of this volume with the belief that this was the conclusion it would show. Yet before opening the maps or considering the analytical tables in detail, the reading of the text itself indicated that water only could account for it.

We turned to the authors' own conclusions—here would be the key which we had fallaciously hoped to find by our own unaided deductions from the data. Alas! flies, food, milk, servants, contact, oysters, everything is considered, all are eliminated, water is left. Then water is rejected too; nothing is left and that terrible 88% of native primaries unaccounted for remains, except for the hypothesis of some new factor not yet accepted or even guessed at by epidemiologists.

It is true that the authors admit the water as the objective of all the epidemiological straws. But they do not accept it,

because the water was of good sanitary quality, as judged by present standards. *Perhaps our standards are wrong.* Let us theorize a little.

First, the Washington water is sedimented before filtration, and so far as the very scant figures given permit any deduction, the larger percentage of such bacterial purification as is achieved occurs during sedimentation. The subsequent purification by the filters *as judged by the percentage removal* of the bacteria *left after sedimentation* is not consistently good.

What is the theoretical effect of sedimentation? Judged by the laboratory technique employed to secure pure cultures of typhoid bacilli from feces (p. 114 of this report) sedimentation (in the laboratory) is expected to get rid of the non-motile and slow moving bacilli (including the colon bacillus) and leave in the supernatant liquid the actively motile bacilli, including the typhoid organism. If this occurs in sedimentation basins on a large scale as it is supposed, with reason, to occur in the laboratory on a small scale, then a low count and absence of colon bacilli from a filter effluent where sedimentation precedes filtration does not mean the same degree of typhoid purification as it does when preliminary sedimentation is not operative. To follow this hypothesis for a moment, sedimentation may be a method of removing the bulk of the bacteria of the raw water, but not a proportionate bulk of the typhoid bacilli. The subsequent filtration, attaining a direct removal of only 60–90% of these, (the figures showing the percentage removal are very few) would not be enough to ensure safety. Remember that to supply 376 cases from a population of over three-hundred thousand persons in six months means only that out of one hundred and eighty million drinks of water taken (at three drinks per head per day) only 3760–7520 need be badly infected, for basing our estimates on not over the usual rates, about 5—10% of those infected succumb. Ten thousand infected drinks out of 180,000,000 means only that one glassful in every 18,000 is seriously infected. Is it hard to believe that this much infection from the Washington water may occur when colon bacilli and gas-producing organisms are not infrequent in the effluent and in the tap water? Is it not easier to believe this than any other hypothesis?

Again, the reduction in typhoid death rates of most American cities in which purification by filtration has been installed do not compel the unprejudiced critic to expect perfection of them. Clark and Gage showed that the general bacterial efficiency must be very high (98 or more %) to secure any colon efficiency, or by inference typhoid efficiency worth mentioning. Analytical work personally known to the writer shows that colon bacilli admitted to mains may remain to contaminate the tap water for three months; and epidemiological work done personally by the writer shows that typhoid bacilli admitted to mains probably survive about one month. It is exceedingly suggestive that our authors found the analytical results f om the tap water notably worse than the average of those made on the filter effluent.

Again, any filter may "break", and if this coincide with the presence of typhoid in the applied water, the mains become infected and as above stated we have evidence that the typhoid infection so admitted to the mains may remain a month in the mains. One such "break" per month may keep up a slight but continuous infection of the mains sufficient to produce one case per thousand population in every six months. There is evidence that such "breaks" occur in Washington. Perhaps coagulants, urged by the engineers from the first, would prevent these, as they were intended to do. Of that let them speak.

We believe that a pure water supply should be absolutely pure all the time if typhoid is to be eliminated, and we do not believe that approximate purity for part of the time is sufficient. Strenuous measures alone will purify a water recently contaminated. Nature provides certain broad general methods—time, sunlight and natural filtration, among the best. He who would imitate Nature must imitate the best and most perfect samples of her work: for Nature botches nine-tenths of her results through imperfect facilities.

A sagacious suggestion has been made to settle the question of Washington typhoid by hypochlorite treatment of the water. This, properly carried out would eliminate, without much cost, all doubts concerning the water. If it be found that Washington typhoid does not very materially decrease under such treatment, then it will be time to look for the fourth dimension in typhoid

epidemiology—the unknown-factor hypothesis, which our authors hesitatingly suggest. The sum of $5000 thus expended for six months would not alone determine the responsibility of the Washington supply itself, but would clear up an epidemiological question of the highest importance to the South as well as to the North.

In conclusion the writer wishes to make clear his belief, i. e., that the vast majority of the true native primary cases of typhoid fever in Washington otherwise unaccounted for are due to infection conveyed to them by the Washington water; and he bases this conclusion entirely on the figures presented in this report. He has nothing but the most sincere praise for the investigative work done, and in fact criticizes nothing concerning the report itself except the failure to draw what seems to him the only logical conclusion from the figures.

H. W. HILL.

[Minn. State Board of Health.]

The Water Supply, Sewerage and Plumbing of Modern City Buildings, by WM. PAUL GERHARD, C. E., N. Y. *John Wiley & Sons, First Ed., 493 ps., 214 cuts, 25 diags. and tables, 1910.*

This excellent, practical manual by an engineer who has already published about twenty books and papers bearing upon some branch of Sanitary Engineering, is the outgrowth of various lectures and essays on the "Water Supply of Buildings" and on "Plumbing" previously delivered or written. The chapter headings are as follows:

Chapter I presents in an elementary form the essentials of the sanitary and hydraulic work of modern buildings.

Chapter II discusses sanitary fixtures and appliances.

Chapter III explains advanced and simplified plumbing methods, and in connection therewith gives suggestions for vital improvements tending to modify and simplify the present methods which are not in the author's judgment altogether satisfactory. For many years he has striven for the simplification of complicated plumbing systems, and is reaping the reward of see-

ing his ideas gradually coming into practice. He stands first and foremost for simplicity and safety.

Chapter IV deals with plumbing in its public health aspect, and with the municipal control of plumbing. In this chapter the modern views concerning the character of sewer air are carefully discussed, and the author pleads for well arranged plumbing even though he believes that sewer air is not a discernible cause of disease.

Chapters V and VI deal with the problems of the supply of water to residences and modern high buildings respectively.

Chapter VII has to do with the maintenance of pipe systems and is prepared chiefly for the managers of institutions and buildings.

Chapter VIII contains a complete set of rules representing the author's idea of the best modern practice regarding plumbing, water supply, and sewerage.

In Appendix A there is an excellent glossary, and in Appendix B there is an excellent account of the history of the development of the art of drainage and plumbing of habitations.

Appendix C contains a plumbing specification reminder and a collection of several hundred reminders which will be found useful in the preparation of plumbing specifications, and which are the outcome of nearly thirty years practical experience.

The illustrations of this book are excellent and modern, and all of them show in an admirable way the present state of the art. Especially serviceable both as to kind and arrangement are the hydraulic and other diagrams and conversions tables, many of which are original and many are drawn from unusual sources. The book is rather elaborate in places, and some of the chapters might be condensed. There are many repetitions which the author states have been made purposely in order to have each chapter complete in itself. The book is true to its title and is a description of methods and appliances rather than a treatise on the hydraulics of water piping and plumbing. One could have wished more detailed information on certain subjects. For example, the effect of bends on the flow of water and sewage in small pipes, and the consumption of water for different purposes in families and in office buildings. Such subjects as water purification and sewage disposal have been treated in other books by

the author and are only mentioned in this work. It is eminently a book for engineering and architectural students, plumbers and others, but it is so well and so clearly written that it could be read profitably by anyone interested in the sanitary arts. The subject matter indicates careful and thorough work and the reviewer knows of no book on the subject so practical as this.

R. S. WESTON.

Guide to Sanitary Inspections. By WILLIAM PAUL GERHARD, C. E., Mem. Amer. Soc. Mechanical Engineers. *Fourth Edition, entirely revised and enlarged. Cloth. Pp. 229. New York: John Wiley & Sons. 1909.*

No class of people in any community gives more concern to the health officer than those persistent citizens who send in a steady stream of complaints concerning the back yards of their neighbors and concerning what they regard as the insanitary and dangerous condition of the houses in which they themselves live. The houses thus complained of are always, by the way, rented houses and usually houses for which the complainants wish to cancel their leases. According to this class of citizens, a floor in bad repair, a poorly-drained back yard, a broken fence, or wall paper which has not been renewed for several years is a constant menace to the health of the family, and any one of these conditions (of which there are a hundred more in the same class) may, in their opinion, give rise to practically any malady with which the human race is afflicted, though typhoid fever, malaria, smallpox and cholera seem to be the ailments most commonly dreaded in this connection. Such persons make the life of the health officer miserable and seriously interfere with his usefulness by consuming a large part of the time which he could profitably devote to the real problems of his department.

It was therefore with a profound feeling of thankfulness that Mr. Gerhard's "Guide to Sanitary Inspections" was opened; for, it was argued, here is a book, of convenient size and small cost, which may be placed in the hands of sanitary inspectors, so that they may learn the real place of sanitary inspections, and which, in selected instances, we may even recommend to the citizens

themselves, in order that they may have authoritative confirmation of the health officer's position that ninety-nine times out of a hundred the things of which they so vehemently complain have little or nothing to do with their health, however much they may have to do with their esthetic sensibilities and with their desire to get even with the landlord.

The opening paragraph quotes what the writer says is a recent statement (authorship not given): "Of all the buildings put up in the United States, not one in a hundred is made to submit to any official regulation. The local government knows nothing of the plans of the builders or architects: there are no sanitary regulations.* * * * * No wonder that malaria and disease are common throughout the country!" What a striking manner of introducing the subject, we thought, by making the issue right at the start and showing how exaggerated and silly are popular conceptions of the origin of disease—a fine way in which to lead up to a rational exposition of the real place occupied by sanitary inspection to-day, in the light of accepted sanitary knowledge.

But alas! It rapidly becomes apparent that this is the position of the author himself; for on page 5 he quotes with entire approval the following: "The wisdom of not entering upon residence in any old house until its healthy (*sic!*) condition is vouched for by some competent authority, it would be a work of supererogation to affirm, seeing how many sicken and perish for want of the most ordinary care in this respect. In town and in country alike, when this precaution has been neglected, Nemesis, in the form of some indisposition or another, is *certain* (italics ours) to overtake the careless occupant. This axiom is, unfortunately applicable to modern houses built in the present decade, as many a sorrowing heart can testify."

By this time we are brought to realize that the author is really serious in such beliefs. Page after page, by quotations and by his own statements, the author takes the firm stand that insanitary dwellings occupy the very first place as a cause of disease and death. At this point the reader is forced to one of two conclusions: either the author simply adheres to doctrines which, always obscure and ill-defined, have finally been almost completely abandoned by sanitary authorities of

to-day, or else he has gone further than others and discovered additional evidence in the case and is prepared to prove that there is in fact more in these things than is recognized by present-day sanitary science. If the former be true, then this "sanitary guide" is hopelessly out of date; if the latter be the true explanation, then the author should realize that he has a new message of the utmost importance to all public health workers, and it becomes his plain duty to enter very fully into an account of just what diseases are "certain" to overtake the man who is rash enough to live in a house which has not been thoroughly inspected by a sanitary expert and to explain just how the dire results are brought about. He cannot be relieved of this plain duty by the disclaimer in his preface, in which he pleads the necessity for brevity in explanation of why "it was not feasible to give in detail the reasons why certain constructions or arrangements are deemed to be defective and unsanitary."

If the theories of the author were applied by him to tenements and hovels alone, much that he claims would be admitted, but he expressly states, over and over again, that what he says applies equally to the finest class of dwellings in our cities.

Were the author unknown, or were he not known as a man of recognized ability along just the lines treated of in his book, it would be impossible to escape the conclusion that his views on many points were hopelessly muddled. For example, although throughout the volume the old bogy of "sewer gas" is not held up as the cause of endless human ills, and although he is careful to explain that there is in reality no definite substance properly called sewer gas, and although he sedulously avoids the use of this term and substitutes for it "sewer air," still, while giving up the older term, itself, he accredits "sewer air" with most of the malevolent effects formerly attributed to its predecessor. One of the reasons why sanitarians substituted the term sewer air for sewer gas was their recognition of the fact that so deep-rooted were the fallacious ideas concerning the evils of sewer gas that the name itself, as well as the conceptions as to its evils, would have to go. To use the term sewer air and then attribute to this all the evils formerly associated with sewer gas would soon necessitate the abandonment of the newer term. In numberless places the evils of sewer air are given great promi-

nence in the present volume, but the most extreme illustration of the position taken by the author is where he states (page 25): "Pan-closets, found even to-day in finer houses, with otherwise good plumbing-work, are *generators of sewer air* (italics ours.) Comment is unnecessary.

Discussing the water supply of country homes, the author states that "as a rule, a qualitative analysis is sufficient to throw light upon the unwholesomeness of a suspicious water; in more important cases, however, a quantitative analysis should also be performed." It would be interesting to know what substances, detectable by sanitary chemical analysis, are found in a polluted water and are not present in ordinary waters which are entirely wholesome. Such simple qualitative tests would be a godsend to water analysts of to-day, who are coming more and more to realize the weakness of even the most careful and thorough sanitary chemical analyses, and who certainly make such deductions as they are willing to make at all from analytic data only after most painstaking consideration of the actual and relative amounts of substances contained in practically all waters.

Regarding disposal of sewage from a country home, the author advocates as a perfectly safe and satisfactory method, the use of a tight sewage tank, from which the accumulated sewage may "be pumped by means of an ordinary garden pump with hose attached, and then distributed in the vegetable garden." Rather remarkable that vegetables thus fertilized should be innocuous to individuals so sensitive that they are made ill by living in a house situated on made land or by the odors from a manure heap!

In the last pages of the volume, the author evidently fears that, in spite of all the warnings of the mysterious, though none the less inevitable and fatal, afflictions which are "certain" to overtake the dweller in a house which has not undergone a rigid sanitary inspection, the reader may not yet have been sufficiently impressed with the gravity of the situation and may, perchance, be bold enough to imagine that he can himself properly inspect the dwelling which he is about to occupy. But say not so! *Real* sanitary inspection of a house is a serious matter. No room for doubt is left on this point, for, says the author: "If in making a sanitary house-inspection, it is con-

sidered impracticable to remove tight woodwork, rip up floors, cut up walls, dig holes, so as to clearly expose every fixture, trap, and every foot of waste or ventpipe, and to gain access to the interior of drains, or to make sure that no old cesspools exist under a house, the results of the examination will enable the inspector to make a general or preliminary report only."

And even this is not all, for the author tells his now thoroughly alarmed reader that he desires "in conclusion to emphasize the necessity of a *periodical* inspection of the sanitary condition of all kinds of buildings. It is not sufficient to spend once a large amount of money to put the sanitary arrangements in a good condition. Constant supervision and thought are required to keep everything in good order.

One cannot but close this remarkable book with the horrible realization that unless he is able to employ ("retain" might be a better word) a sanitary expert to tear down his house, rebuild it and then stay constantly on the job of inspecting it forever thereafter, he had best take at once to the woods and live in no house at all. But stay, there is after all another solution of the problem—the one at which it is hoped that ninety-nine out of every hundred readers will most probably arrive. What this more consoling view of the whole case is may safely be left unstated.

The perusal of Mr. Gerhard's book leaves one more than ever convinced of the necessity for some safe, sane and modern compend on sanitary inspections. This class of work will always be required of health departments in our cities, and it has a distinct and decided field of usefulness. We no longer dread sewer gas as did the last generation of sanitarians, but we none the less continue to insist on proper plumbing, for reasons which it would be the function of such a work to state. We know that it is absurd for anyone to complain of uncut weeds in his neighbor's lot on account of the noxious effluvia which arise from them and which he fears may give him malaria, but these same uncut weeds are bad nevertheless, for they nearly always serve as a hiding place for many old tin cans (thrown there, most likely, from his own kitchen), and these, collecting water after each rainfall, serve as excellent breeding places for mosquitoes, some of which may be the malaria-bearing anopheles. We laugh at the man

who complains that "the odor from the stable across the street is enough to give us all typhoid fever." But only his theory is wrong and not his facts; for the odor of which he complains is due to decomposing horse manure, and this is the ideal breeding place for flies, which may in fact bring typhoid fever into his home.

It is greatly to be hoped that someone with clearcut views on matters such as these, and with the ability to express these views in a fashion so simple and yet so attractive as to appeal to the general public and to the sanitary inspectors of municipal health departments, will soon fill the need now existing for a rational "Guide to Sanitary Inspections."

E. C. LEVY.

The Science of Living, or The Art of Keeping Well. By WILLIAM S. SADLER, M. D. *Chicago, A. C. McClurg & Co., 1910.*

This is a semi-popular work in the field of general hygiene. It is of unusual scope and detail. The amount of information compressed into it gives evidence of exceedingly careful selection of material. Possibly there is too much—the rapid succession of topics and precepts tending to bewilder the reader. But the merits of the book are many. Its order and proportion are excellent. The writer shows independence in observation and suggestion without being eccentric, and he rarely rides a hobby. If we detect one at all it is "high-blood pressure." The estimate placed upon mental factors in health is fair and temperate. The subject of nutrition is treated ably and the tables relating to dietaries are novel and interesting. A penchant for striking statistics seems to be a foible of the author but it is not often too prominent. We believe his figure for the number of cells in the human body is one which originally stood for the number of corpuscles in the blood; perhaps the string of ciphers is sufficiently impressive but it is well to be accurate. It would be quite unjust to make much of the inevitable flaws in the book; it will not mislead its readers but will rather prove practical and helpful beyond most of its competitors.

PERCY G. STILES.

Principles of Hygiene: For Students, Physicians, and Health Officers. By D. H. BERGEY, Assistant Professor of Bacteriology, University of Pennsylvania. *Third Revised Edition. 555 pp. Philadelphia and London. 1909.*

The third edition of Bergey's Hygiene shows considerable changes by comparison with the volume issued five years ago. In particular, the chapters on sewage disposal and on immunity have been extensively enlarged and rewritten and new discoveries, such as those relating to the etiology of plague and syphilis, have been incorporated.

The reviewer is inclined to believe this one of the best, if not the very best, textbook of hygiene in the English language. Every year, however, the idea of any single book, or course of lectures, covering such a subject as "Hygiene," becomes more and more anomalous. The wide field of public health work, with which this much misused word is held to be synonymous, covers medical subjects like personal hygiene and the control of the communicable diseases; bacteriological subjects like immunity, and water and milk examination; chemical subjects like air and water analysis; purely engineering subjects like water purification and the disposal of sewage and garbage—and vital statistics. It is clearly impossible to treat any one of these five distinct classes of problems satisfactorily in less than a single book, while many of their minor subdivisions require large volumes for satisfactory elucidation. The time must some day come when medical schools will abandon the fruitless attempt to teach a smattering of the details of a dozen different sciences under the name of "hygiene," substituting a course in the broad principles of sanitary science, for the ordinary practitioner, and a really valuable graduate course for the public health specialist. Prof. Bergey in the present volume has minimized the evils of the prevailing type of book to a very considerable degree. He says in his original preface: "No attempt has been made to treat the subject in an exhaustive manner, the object being merely to give the general principles upon which the health officer and the physician work in their respective capacities in dealing with conditions which are detrimental to health or which tend to

improve health." The peculiar value of the book lies in the fact that the author has succeeded to an unusual degree in confining himself to general principles. Nevertheless, the bulk of the volume is still concerned with details, calculations of cubic feet of air space, chemical analyses of water, construction of sewage disposal plants, dietetic formulae, school seats, vaccination against specific diseases, etc. The shortcomings of a book of this type are not the fault of the author but are to be charged to the tradition which demands that medical students shall be made to believe that they have a knowledge of public health practice, (as opposed to public health principles), a knowledge which they cannot acquire without prolonged and specialized study in various fields.

Coming to specific details, air supply and ventilation are among the best handled of all the subjects in the book. It might be well to make clearer the importance of temperature and humidity in producing the lowered vitality associated with bad air; and Professor Bergey's statement that small amounts of carbon dioxid depress vitality and that the bad effects of respired air are in part due to this gas seems to require substantiation. The testimony of the best experts in England and Germany, as summarized for example in the recent reports of the Royal Commissions on Factory Ventilation, points to heat and moisture as the chief, and perhaps the only, well-established properties of bad air.

The chapters on sanitary engineering are less satisfactory. The author does not appear to distinguish clearly between the fundamental aim of water purification, which is the straining out of bacteria, and the fundamental aim of sewage purification, which is the oxidation of organic matter. The reduction in nitrogenous matter in a water filter, figures for which Prof. Bergey quotes, is quite beside the point. Under garbage, high temperature destructors, which now occupy the center of the stage, are not even mentioned, and some very dubious cost data are quoted. The treatment of chlorin disinfection of water is naturally out of date, for the last two years have revolutionized water works practice in this regard. There are apparently clerical errors on p. 157 where it is stated that sewage is composed of "998 parts of water, 1 part of urine, and 1 part of

organic matter," and on p. 168 where the number of persons to an acre of sewage irrigation area is given as 2,000.

Professor Bergey's general treatment of dietetics and the hygiene of feeding is well done. The most surprising thing in this chapter is that under milk the word Pasteurization seems not to be mentioned. It certainly does not appear in the index. Yet cities are turning more and more to pasteurization as one of the most useful practical methods of dealing with this problem; and the home pasteurization of baby milk is certainly an indispensable part of infant hygiene.

The chapters dealing with exercise and clothing and personal hygiene seem to the reviewer excellent. The chapters on Industrial Hygiene and School Hygiene are also well done. From the former, a table of average age at death in various occupations, which is not a useful form of statistical statement, might well have been omitted, however.

The treatment of Immunity, in Chapter XVII is an exceptionally fine piece of work. Into ten pages of text Professor Bergey has compressed a really admirable digest of the fundamental principles of immunology and in the rest of the chapter he gives a careful and timely review of most of the recent practical advances in this science. In this same chapter is a table giving the etiologic factor, avenues of entrance, sources of infection, modes of dissemination, and preventive measures for thirty-eight acute infectious diseases, which ought to be radically revised in another edition. Direct contact, now recognized as of such supreme importance, appears as a source of infection only under scabies. "Fomites and infected dust" is given as the source of infection for Pneumonia and Tuberculosis, and Fomites alone for Diphtheria, Erysipelas, Cerebro-spinal Meningitis, Influenza, Small-pox, Measles, Scarlet Fever, Mumps, Whooping Cough, Carbuncle, Favus, and Varicella. Perhaps Prof. Bergey means to include under fomites, handled food, drinking cups, mouth spray and other forms of more or less direct contact. In the ordinary sense in which the word is used, however, it implies remote transfer by inanimate objects, such as bedding, clothing, etc.; and in this sense its importance is rapidly dwindling almost to disappearance. The chapter on disinfection is well handled; but in regard to isolation and quarantine it seems unwise to devote 67

pages to the full text of quarantine laws and only 2 pages to the really important problem of house quarantine, (or isolation).

On the whole, the book is an excellent one, for the most part accurate, well proportioned and judicious. Professor Bergey has produced a treatise on hygiene which is perhaps as good as any book can be which attempts the task of treating such a vast and diverse range of subjects in a single volume.

C.-E. A. WINSLOW.

Primer of Sanitation. By JOHN W. RITCHIE, Professor of Biology, College of William and Mary, Virginia. *Illustrated by Karl Hassman. Yonkers, N. Y. World Book Co., 1909.*

The reviewer is wholly unacquainted with any book of its kind in the English language that addresses itself with such brilliant success to those for whom it is designed.

The manner of the plan of presentation of the subject matter is so logical throughout that it would be hard to suggest any improvement.

Beginning with the first chapter, it is shown why the study of bacteria and diseases are so necessary; the second chapter deals with the cellular structure of the human body; the third with how germs enter the body; the fourth with the struggle between the body and the invading bacteria; and succeeding chapters with discussions on bacteria in general and in particular; how to avoid disease; how to care for the sick; how to prevent the spread of disease; protozoal diseases; the house-fly and its malevolent ways; food and its relation to the spread of diseases; disinfection; unhygienic habits; practical sanitation; public sanitation; and an appeal for wise governmental interference and control in matters of the public health; all leaving little to be further desired.

The success that the "Primer" will certainly meet with lies in the very happy and effective way in which the author has succeeded in actually *talking* to his readers, so that it would seem that not even the most stupid of his audience could fail to grasp the significance of what is so interestingly and truthfully portrayed everywhere throughout the book.

One feature of the book is the appending of simple resumes at the ends of the chapters, embodying the chief points sought to be driven home and remembered by the pupil. Another noteworthy feature appears in the chapters dealing with infectious processes, namely, in the repeated advice given to the pupil to seek the counsel and guidance of the intelligent physician.

The reviewer feels certain also that the book has a message for the teacher as well as for the pupil; for ignorance of the simple hygienic principles is often to be found ensconced on the rostrum as well as at the desk.

The advent of the "Primer" assuredly marks the beginning of a new era and now paves the way for the execution of the suggestions expressed by Dr. H. W. Hill* of the University of Minnesota, at the Baltimore Meeting of the Society of American Bacteriologists, that Bacteriology in the form of simple demonstrations be introduced in grade and grammar schools in the endeavor to make familiar some of the everyday important facts of bacteriology connected with the home life and human intercourse. Time could readily be found for this by deleting some of the hours given to the dull and deadening routine of the teaching of physiology. Such a change would make for a more intelligent and healthful class of citizens and a better citizenship—"*mens sana in corpore sano*"!

The book is well printed on good paper, attractively bound, and is remarkably free of typographical and other errors. There exists, however, one noticeable error in the brief biographical note appended to the engraving of the late Dr. Walter Reed, (Fig. 57); it is to be remarked that Dr. Reed neither allowed himself to be bitten by a yellow-fever mosquito, nor did he die from yellow-fever. The author evidently had in mind the case of Dr. Jesse W. Lazear who was associated with Dr. Reed in the investigation of yellow-fever.

NORMAN MacLEOD HARRIS.

[University of Chicago.]

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*Hill, H. W.: *Science*, 1909, xxx n. s., p. 625.

Girl and Woman. By CAROLINE W. LATIMER, A. M., M. D. *D. Appleton & Company, New York and London, 1910.*

The author of this work was formerly instructor in biology in The Woman's College of Baltimore. The sub-title is "A Book for Mothers and Daughters," but the reviewer believes that all medical students, as well as many practitioners and teachers, will find this book well worth owning. In its 318 clearly printed pages, and in the introduction by Dr. Kelly, of Johns Hopkins, we find presented in an interesting, intelligible way the gist of the physiological and psychological knowledge that some of us have tried to get from Dr. G. Stanley Hall's painfully monumental work on adolescence. From many scattered sources Dr. Latimer has amassed material that after her careful study and sifting gives us the main facts., as well as the most important views and ideas suggested by them. In a simple, compact form, easy of comprehension by almost any reader over thirteen years of age, we find a description of that most important period in life as regards the formation of habits and character, the years between childhood and maturity. Among the subjects considered are the physiology of girlhood during the transition to womanhood, some of the more important physical, mental and moral disturbances often met with during that wonderful period and some practical measures for their prevention and cure.

The nature of reproduction, in the lowest forms of life as well as in man, is well described, and in this part of the work the author's experience as a teacher of biology shows to advantage. Quoting directly from her: "For a girl to grow up uninformed of these facts and of the natural laws connected with them is doing her a great injustice, because she then enters life unprepared for some of its most serious problems and may have to pay heavily in health or happiness for her ignorance. The open, direct treatment of such subjects is a duty parents owe to their children." The perplexing question of menstruation is taken up in a most thorough manner. In the chapter on bodily functions, digestion, respiration, exercise and sleep, and also common errors in regard to them, are given the attention that their great importance deserve. There follow chapters on personal hygiene, including bathing, care of the skin, complexion, teeth, hair,

hands, feet, eyes and ears, daily life during school days, including influences of the home, of the school, of the social life of the school girl, of amusements, of relations with the other sex, and of reading; daily life after leaving school, divided into home life, college life, self support and dress. The final chapter takes up the commoner minor ailments of girls and young women, e. g., headache, indigestion, constipation, colds, over-fatigue, and points out the danger in certain alleged remedies.

The book is interesting and valuable and will go far toward meeting the needs of thousands of girls and women now seeking such information.

H. LINCOLN CHASE.

[Brookline, Mass.]

The Germicidal Effect of Water from Coal Mines and Tannery Wheeles upon Bacillus typhosus, Bacillus coli and Bacillus anthracis. Laboratories of Department of Health of Pennsylvania, Pennsylvania Health Bulletin, No. 5, Harrisburg, Pa., Nov. 2, 1909.

The laboratories of the Department of Health of Pennsylvania, recently made a study of the germicidal effect of water from Coal Mines and Tannery Wheels upon *B. typhosus*, *B. coli* and *B. anthracis*. This investigation was undertaken because of the fact that the water supplies of many of the largest cities of the state are located on streams which receive extensive drainage from coal mines, sewage from many scattered settlements and manufactural wastes, especially tannery sewage.

It has been noted that under ordinary conditions the waters of these polluted streams are remarkably free from bacteria except during floods when the large volume of fresh water is sufficient to overcome the acidity of these mine wastes and it is thus apparent that acid mine drainage and spent tan-liquors have the power to destroy sewage organisms in natural water courses. This power has been recognized by the State Department of Health of Pennsylvania, in its decrees relative to the disposal of sewage into streams which carry mine waste and tannery sewage.

The importance of this matter led to the above mentioned experiments to determine more definitely the actual effect of certain liquors upon certain micro-organisms.

Mine water from a coal mine and spent tannery liquor from a sole leather tannery were used for the tests. The mine water was typical of that which is constantly flowing to the lowest point in the mine and which must continuously be removed in order that the mining of coal may not be interrupted.

The spent tannery liquor results from the process of tanning hides with quebrach extract. The liquor used in these tests was obtained from the "color-wheel" whose purpose is explained as follows: After the fleshings have been removed and the hair loosened by lime and removed by a de-hairing machine, the hides are washed and then placed into a color-wheel or tank which contains a weak solution of tannic acid derived from the tanning liquors used in the regular tanning process. This color-wheel liquor contains the only tannic acid that is ordinarily wasted from extract sole leather tanneries. At this particular works operating two wheels, the total quantity of color-wheel liquor is about 12,000 gallons, daily. The total waste from this plant is in volume about 100,000 gallons, daily, and contains in addition to the above, waste from soap fats, wash wheels and vats, lime vats, acid vats, and the de-hairing machine.

In the laboratory the mine waste and the color-wheel-liquors were tested for germicidal action using *B. typhosus*, *B. coli* and *B. anthracis*. Various dilutions and periods of observation were studied. The general conclusions were as follows:

Mine water prevents the growth of the typhoid bacillus in one hour's contact. This waste markedly limits the growth of *B. coli* causing progressive death and preventing cultivation after 24 hours. Spent tan liquor limits the growth of the typhoid bacillus and causes its destruction after six hours. It does not destroy *B. coli* until after a 24-hour period of contact. *B. anthracis* is not eliminated by tan liquor, indicating that its spores are not especially effected by the tan liquor studied.

The broad conclusions from these studies are that it would be a mistake to exclude mine water and spent tan liquor from streams which may eventually become sources of drinking water, for it is apparent that neither typhoid nor coli and inferentially

the cholera organisms can survive the sulphuric acid present in acid mine drainage. The distance in which mine or tannery waste will be effective has not yet been definitely determined. Mine waste will evidently continue to be effective at a much greater distance than tannery waste. The latter should receive treatment sufficient to destroy anthrax spores before it is discharged into streams.

A. E. KIMBERLY.

[Columbus, Ohio.]

A Review of Twenty-one Years' Experience upon the Purification of Sewage at the Lawrence Experiment Station. H. W. CLARK AND STEPHEN d'M. GAGE. Report Mass. State Board of Health, 1908.

An abstract and condensed review of twenty-one years work on the part of a large crop of assiduous workers must necessarily be incomplete, for the authors have packed into 288 pages the summaries of the annual reports of the State Board of Health since 1890.

The Lawrence Experiment Station was established in 1887 and has been operated ever since with constantly widening scope. The first report was made in 1890 by Hiram A. Mills, C. E., and contains results of experiments with the intermittant filtration of sewage through sand, gravel, and other soils at varying rates and under different conditions of application. These experiments first established the now well known facts of the intermittant process, chief of which are the part which nitrification plays therein and the fact that this action is affected by the exposing of the sewage in a thin film to the action of air and bacteria. The 19 filters which were operated up to the end of 1890 furnished much data regarding the mechanical and physical properties of materials employed in filtration, the storage of nitrogen in the filters, the period of flow of sewage through filters 5 feet in depth, nitrification and the nitrifying organisms, methods of analysis and investigation, the chemical precipitation of sewage, etc.

The report for 1891 contained data regarding the permanency of filters and the effect of the organic composition of the materials used in the filters upon the quantitative and qualitative efficiency

of the filters. It is interesting to note the operation of a gravel filter during this year at the rate of 220,000 gallons per acre daily, the sewage being applied in 60 or 70 doses per day. This filter was very similar in principle to the so-called trickling or sprinkling filter, which has been developed in England during the last 15 years. Although this filter gave good nitrification results without artificial aeration, it was never recommended under Massachusetts conditions, which, generally speaking, favor intermittant filtration. It is impossible to describe in a few words the special studies into the details of intermittant filtration, which were made in the next few years. They included the studies into the different methods of operating filters, the physical properties of sands and gravels with special reference to their use in filtration, and also the composition of sewage and the changes which occur as it becomes stale. This latter work ante-dated the so-called septic tank, which took advantage, like its predecessor, the cesspool, of the fact that the storage of sewage decreases the organic nitrogen and increases the free ammonia in sewage stored therein.

In 1895 were made the first experiments upon the purification of manufacturing wastes. Filters which were artificially aerated were also tried and their capacity to produce stable effluents was noted. Under these conditions coarse filters were operated at rates of one million gallons per acre daily, and produced generally stable effluents containing high nitrates. Equally good results were obtained whether these filters were aerated slightly and artificially or not.

In 1897 extended experiments were begun on the purification of sewage by the so-called contact filters. In 1898 studies with the so-called septic tank were begun. In 1899 a trickling filter 10½ feet in depth and operating at a rate of two million gallons per acre daily was put into operation. In 1898 the studies were first made showing the advisability of disposing of the sludge from septic tanks by hydrolysis out of contact with the sewage as far as possible and that contact action in tanks of this character is a most favorable factor. In this connection experiments were made with tanks filled with large stones. In 1901 the stability of sewage effluents, especially from contact and trickling filters, was thoroughly investigated. Two slate filters were put into

use similar to those used in England by Dibdin. In 1903 special studies of the operation of the filters, especially during the winter, were made; also much chemical and bacteriological work in connection with the disposal of manufacturing wastes and bacteria of nitrification and reduction. These special studies have been continued to date and comprise a mass of special investigations into most of the details of sewage purification. From 19 filters in 1890 the number of filters studied increased steadily to 250 filters at the end of 1908. While some of the filters have been discontinued, most of the original 19 are still in very successful operation. In connection with these experiments about 50,000 chemical and 150,000 bacteriological analyses have been made. The sewage used was from the main sewer of the city of Lawrence and is distinctly domestic in character. The sewage on reaching the station has lost its dissolved oxygen and has undergone a slight decomposition or septic action, not so great, however, as to unfit it for experimentation in hydrolytic and other septic tanks. It is somewhat stronger than the sewages of other Massachusetts cities. It is about as strong as the average English sewage.

For details regarding the character of Lawrence sewage and the conditions under which intermittant filters and some other sewage purification devices operate successfully, the reader must be referred to the text of the review. There is the interesting conclusion that in all of the processes the chief dependance for purification must be upon putrification and nitrification, both of which are brought about by biological means. Of the devices employed, septic and hydrolytic tanks and contact filters are most favorable to putrifactive action, while trickling and intermittant filters are most favorable to the nitrification processes. Generally speaking nitrification processes bring about a more complete reduction in the amount of organic matter and the numbers of bacteria contained in domestic sewage.

This summary is to be followed next year by a similar one on the work at Lawrence with manufacturing wastes. The authors are to be congratulated for bringing within readable limits the important facts derived from these twenty-one years of fruitful effort.

ROBERT SPURR WESTON.

The Propaganda for Reform in Proprietary Medicines. Sixth edition. Containing the various exposés of nostrums and quackery which have appeared in The Journal of the American Medical Association. Price, paper, 10 cents; Cloth, 35 cents. Pp. 292. Illustrated.

This book presents in convenient form most of the exposures that have appeared in The Journal of the American Medical Association showing fraud either in the composition of various proprietary preparations or in the claims made for such preparations. Many preparations of the "patent medicine" type have been subjected to analysis and the results of such examinations appear in this volume.

ANNOUNCEMENTS AND NOTES.

IMPORTANT LEGISLATION AFFECTING EVERY READER. Owing to a recent strict interpretation of the postal regulations, this JOURNAL as well as the Journal of the American Medical Association, the Journal of the American Chemical Society and similar scientific publications are threatened with a loss of their second class ratings unless they discontinue carrying advertisements or unless the society or association grants members the choice of receiving or not receiving the Journal of the society; in the latter case, at a lowered membership fee.

Either of the above steps would mean a reduced revenue while to pay third class rates would greatly increase running expenses. In any case the added financial burden would have to be met by an increased subscription rate paid either directly, or indirectly through the association, by the reader.

Relief from the above conditions is offered by either of two bills now before Congress; House Bill No. 22239 (Mr. Dodds) or Senate Bill, No. 7521 (Mr. Owen), which allow to journals of scientific, benevolent or other societies the same right to advertisements enjoyed by the commercial press. We urge YOU to write AT ONCE to your Senator and Representative requesting them to use every proper means to further this legislation.

STANDARD METHODS OF WATER ANALYSIS. A recent bulletin of the U. S. Department of Agriculture, Bureau of Chemistry, conveys the information that the Association of Official Agricultural Chemists proposes to adopt certain methods there given as standard methods for the analysis of water. The methods as outlined are practically those to be found in Mason's "Analysis of Water" and differ in a number of essential points from the standard methods of water analysis of the Laboratory Section of the American Public Health Association. It would be unfortunate indeed to have two sets of standard methods for water analysis and it is to be hoped that the referee of the A. O. A. C. (W. W. Skinner of the Bureau of Chemistry) may see his way clear to confer with the Chairman of the Laboratory Section Committee, Prof. E. B. Phelps, of the Mass. Institute of Technology.

A NATIONAL DEPARTMENT OF HEALTH. The Committee of One Hundred of the Association for the Advancement of Science, has recently published a folder giving the following reasons

WHY THE PEOPLE OF THE UNITED STATES SHOULD HAVE A DEPARTMENT OF HEALTH.

1. To stop the spread of typhoid fever through drinking sewage-polluted water of interstate streams.
2. To enforce adequate quarantine regulations, so as to keep out of the country plague and other similar pestilences.
3. To supervise interstate common carriers, in so far as without such supervision they prove a menace to the health of the traveling public.
4. To have a central organization of such dignity and importance, that departments of health of states and cities will seek its co-operation and will pay heed to its advice.
5. To influence health authorities, state and municipal, to enact uniform legislation in relation to health matters.
6. To act as a clearing-house of state and local health regulations and to codify such regulations.
7. To draw up a model scheme of sanitary legislation for the assistance of state and municipal health officers.
8. To gather accurate data on all questions of sanitation throughout the United States.
9. To establish the chief causes of preventable disease and unnecessary ill-health.
10. To study conditions and causes of diseases recurring in different parts of the United States.
11. To correlate and assist investigations carried on in many separate and unrelated biological and pathological federal, state and private laboratories.
12. To consolidate and co-ordinate the many separate Government bureaus now engaged in independent health work.
13. To effect economies in the administration of these bureaus.
14. To publish and distribute throughout the country bulletins in relation to human health.

15. To apply our *existing* knowledge of hygiene to our living conditions.

16. To cut in two the present death-rate in the United States as the authorities are agreed might be done.

While we may not care to endorse in full the Owen Bill (Senate Bill No. 6049) the principle is undoubtedly correct and the question should receive the careful consideration of our readers. It is reported* that the opposition to the bill comes largely from a newly launched "National League for Medical Freedom," which is said to have among its directors the president of an Antivivisection Society, the president of the American Druggists Syndicate and some "mental healers." That the new society has ample funds is evidenced by the large advertisements appearing in the daily press which are so worded as to make it appear to the layman that the passage of the Owen Bill will in some way bring a man and his family under the domination of the "political doctors."

MEETING OF THE AMERICAN ASSOCIATION OF MEDICAL MILK COMMISSIONS. The Fourth Annual Meeting of The American Association of Medical Milk Commissions will be held at the St. James Hotel, St. Louis, Mo., on Monday, June 6, 1910. The three sessions will begin at 10 A. M., 2:30 and 8:30 P. M.

The program committee has not completed its work but reports that the following have agreed to be present and contribute to the program: Dr. M. P. Ravenel, of the Universtiy of Wisconsin; Prof. W. A. Stocking, Jr., of Cornell University; Commissioner R. A. Pearson, Albany, N. Y.; Assistant Surgeon-General Kerr, Washington; Dr. E. C. Schroeder, United States Department of Agriculture; Dr. Henry L. Coit, Newark, N. J.; Dr. Collins H. Johnston, Grand Rapids, Mich.

Among the subjects thus far assigned by the Program Committee are—"The Essentials Underlying the Production of Clean Milk," "The Bacterial Content of Milk from Cows Continuously Stabled," "The History, Development and Statistics of Milk Charities in the United States," "The Advantages, the Limitations and Some of the Results of Milk Charity Work," "The Production of Certified Milk."

*Jour. A. M. A., May 28, pages 1792, 1793.

PRIZE ESSAY.—The International Dairy Federation offers a prize of 500 francs ($100) for the best work upon the Comparative Nutritive Value of Raw and Cooked Milk. The conditions under which the prize is offered are as follows:

Article 1. A prize of 500 francs is created for the purpose of rewarding the best work presented in response to a question of scientific or technological character proposed by the permanent Bureau of the International Dairy Federation.

Article 2. The conferring of the prize will be a function of each of the International Sessions of the Dairy Congress.

Article 3. Papers sent in reply to the question submitted should be printed or typewritten and may be drawn up in French, German or English. They should be forwarded in five-fold copy.

Article 4. An international jury composed of five members will be named by the permanent Bureau to judge the papers participating in the meetings.

Article 5. These papers should reach the Secretary General of the International Dairy Federation at least 3 months before the date fixed for the session of the International Dairy Congress.

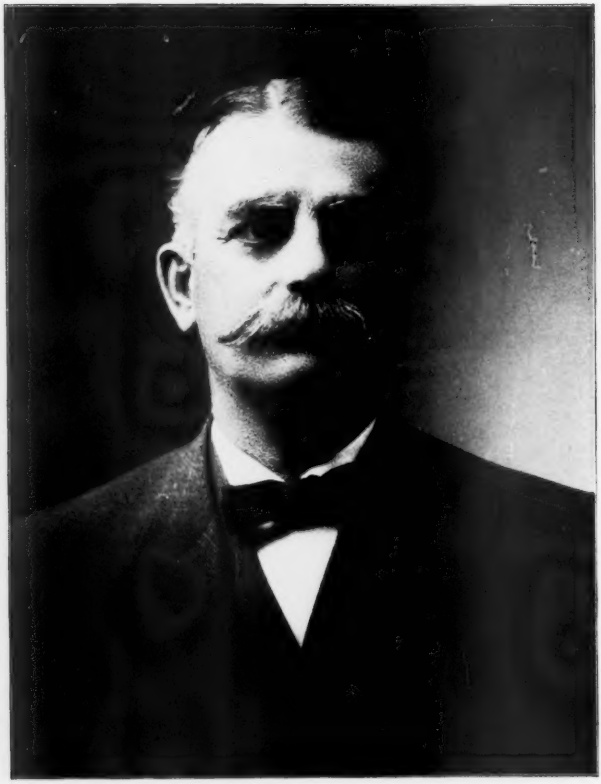
Article 6. In case any paper should be deemed unworthy of the prize, the corresponding amount may be carried over to the next meeting as a reward for a second paper if expedient.

The question submitted by the Congress is as follows:

"To determine by latest experiments, made at least in part on man himself, the comparative nutritive value of raw milk and cooked milk (pasteurized, sterilized, or dessiccated).

"In case of an advantage in favor of raw milk, to determine the role that the enzymes of the milk play in nutrition."

N. B. The papers prepared in response to this question should be forwarded to the Secretary General of the International Dairy Federation, 23 Rue David Desvachez, Brussels-Uccle, Belgium, not later than April 1st, 1911.



FRANKLIN C. ROBINSON,
President American Public Health Association, 1906.
Born April 24, 1852.
Died May 25, 1910.